

Compressed Air

MARCH 1957

Magazine



SHOEHORN NEEDED
TO FIT DAM HERE

Steep, deep gorge is site
of Donnell's structure
in Coast mountains

(SEE INDEX PAGE AND PAGE 64)

VOLUME 62 • NUMBER 3

NEW YORK • LONDON



(Left, A) wide bucket "L" type wheel. (Right, B) regular type wheel for Coppus Steam Turbines

Now...for low steam consumption –
COPPUS TURBINES *can be furnished*
with wide bucket "L" type wheel

Good news for steam turbine users where low steam consumption is important!

The Coppus Type "L" Wheel is the answer to this problem. Larger turbine buckets are employed to make the most economical use of steam.

In every respect the Coppus Turbine offers the top-quality features and advantages that have made the Coppus line outstanding for efficiency and economy. For example:

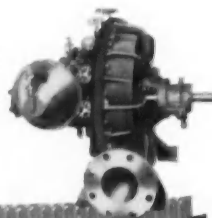
- Turbines rated close to your exact hp

requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.

- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther.* Send for Bulletin 135 on Coppus Turbine.

COPPUS
 ENGINEERING
 CORPORATION
 203 Park Avenue
 Worcester 2, Mass.
 Sales offices in
 THOMAS'
 REGISTER



COPPUS "BLUE RIBBON" **TURBINES**



New Filter Proves Real "Sandhog" in Colorado Dust

Ends daily changing of oil in oil-bath filter



Bulldozers of the Schmidt Construction Co., working a job near Rifle, Colo., were having real trouble. Hour after hour powdered dust swirled up and around the giant earthmovers as they shoved masses of near-moistureless dirt from a construction site.

Even the twice-a-day cleaning of oil-bath filters on the diesel tractors was not enough to keep dust from penetrating the filter. Oily mud was found on the blower screen of one engine taken down; a great amount of wear showed on rings and cylinder walls.

A Dollinger Corp. representative suggested the use of Dollinger's new OTR (off-the-road) dry type filter as a pre-cleaner. It was installed ahead of the oil-bath

filter. Its low resistance made the arrangement practical.

Dollinger OTR's were placed on the dozers for a 30-day trial. Before the time was up, Schmidt had purchased the trial filters and ordered more. The trial revealed these startling facts:

1. No further engine trouble.
2. Crankcase oil much clearer than before.
3. Simple servicing. Dollinger's dry filter material may be blown off with air.
4. An immediate and impressive saving of oil . . . an estimated average saving of \$5.65 per week.
5. After 90 days no dirt was found in the oil-bath filters.

For further details write for Bulletin 110. Dollinger Corporation, 7 Centre Park, Rochester 3, N. Y.



STAYNEW

DOLLINGER



LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • HIGH PRESSURE FILTERS • AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

NEWEST OF THE GARLOCK 2,000

New LOW COST GARLOCK MECHANICAL SEAL

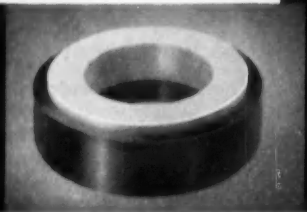
*has "Gem-like"
Qualities!*

The finest quality materials, design, and workmanship have been incorporated in this new low cost Garlock Mechanical Seal for $\frac{5}{8}$ " and $\frac{3}{4}$ " diameter shafts. Other sizes available on quantity orders.

This new low cost mechanical seal is another important addition to "the Garlock 2,000" . . . two thousand different styles of packings, gaskets, and seals for every need. The only complete line . . . that's why you get unbiased recommendations from your Garlock representative.



True Carbon Seal Ring with precision lapped surface. Regarded by all experts as the finest material for one face of any mechanical seal. Perfectly flat sealing surface contacts stationary seal.



Stationary Seal of finest Ceramic is mounted in a molded cup-shaped vibration ring. Its sealing surface is precisely lapped for perfect contact with the carbon seal ring . . . perfectly matched for positive sealing.



Costly Two-piece Shell Construction. Shell rolls over a retainer ring which holds "O" Ring (static seal) in place and also provides a metal surface which gives you an exact mounting position. No danger of incorrect mounting due to improperly located static seal.



Static "O" Ring in Groove permits mounting seal from either direction without disturbing position in shell. Withstands higher pressures (100 psi.) and permits tighter fits than square shaped rings.

Roll Type Bellows provides greater travel than "V" type bellows.

We invite you to compare this new inexpensive Garlock seal with those you are now using. It is designed for use on any rotating shaft of home water pumps, oil pumps, reduction units, washing

machines, etc. Get all the facts, call your local Garlock Representative or write for data sheets on this new mechanical seal.

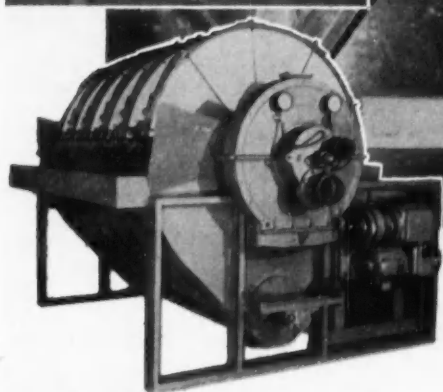
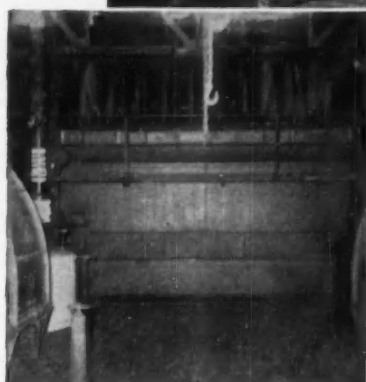
THE GARLOCK PACKING COMPANY, Palmyra, New York

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals,
Rubber Expansion Joints





ORDINARY DISC-TYPE

940 sq. ft. of filter area in 10 discs. It was necessary to by-pass one-fourth of tonnage past the filter to maintain required production level. Processed 17 tons of concentrate per day (75% of tonnage required for profitable operation).

75% production efficiency was achieved only through considerable manual assistance. Excessive down time for filter tank cleaning.

Poor cake discharge required manual assistance. Uneven cake formation. Severe classification rings on outer periphery of disc with thin, slimy cake near center.

Outstanding success of the Eimco Agidisc Filter prompted this firm to convert five other disc filters into Agidiscs. They are convinced these installations are securing a ton of concentrate at the lowest cost per dollar of investment and maintenance.

Capacity Was A Problem . . .

UNTIL THIS FIRM INSTALLED AN EIMCO AGIDISC FILTER

Replacement of the 8' 6" X 10 disc filter with an 8' 10" X 10 disc Eimco Agidisc resulted in these production efficiencies:

EIMCO AGIDISC

1040 sq. ft. of filter area in 10 discs. Efficiently handles the tonnage that formerly was by-passed. Processes 24 tons of concentrate per day. With an increase of 25% in filter area, the Eimco has boosted capacity by 40%.

In achieving 100% production efficiency, Eimco uses efforts of one man part time. Maintenance and labor costs are much less.

Efficient cake discharge without manual assistance. Ability of Agidisc to maintain uniform particle suspension has resulted in even, dry cake formations.

Increasing the efficiency of your plant means greater returns. The Eimco Research and Development Center is staffed and equipped to help you solve your filtration problem whatever it may be. They'll be happy to assist you!

THE EIMCO CORPORATION

SALT LAKE CITY, UTAH

Research and Development Division, Palatine, Illinois

Process Engineers Inc. Division, San Mateo, California

Export Office: Eimco Building, 81-83 South Street, New York 5, N. Y.

BRANCHES AND DEALERS IN PRINCIPAL CITIES THROUGHOUT THE WORLD



B-241

Thoroughly Proved...

**BY YEARS OF HARD
EVERYDAY USE IN
THOUSANDS OF PLANTS**

HANSEN QUICK-CONNECTIVE **PUSH-TITE COUPLING**



Locking pins in Hansen Push-Tite Coupling Socket afford large area contact with plug, thereby preventing wear and subsequent leakage.

QUICK-CONNECTIVE FLUID LINE COUPLINGS for

**AIR • OIL • GREASE
HYDRAULIC FLUIDS • WATER
VACUUM • STEAM • OXYGEN
ACETYLENE • REFRIGERANTS
GASOLINE • COOLANTS**

SINCE 1915



THE HANSEN

QUICK-CONNECTIVE FLUID LINE COUPLINGS

MANUFACTURING COMPANY

4031 WEST 150th STREET

CLEVELAND 11, OHIO

Instant automatic
flow and shut-off

quick
connection
and
disconnection

leak-proof
minimum
wear
locking
device

Integral
factory
assembled
tamper-proof
socket head

ONE-WAY SHUT-OFF

• The ability of Hansen Push-Tite Couplings to withstand severe service — with practically no maintenance — has been thoroughly proved by years of hard, everyday use in thousands of plants. The "socket head", which contains the locking device, is factory assembled into a rugged integral unit which cannot be readily injured or have component parts lost by casual tampering.

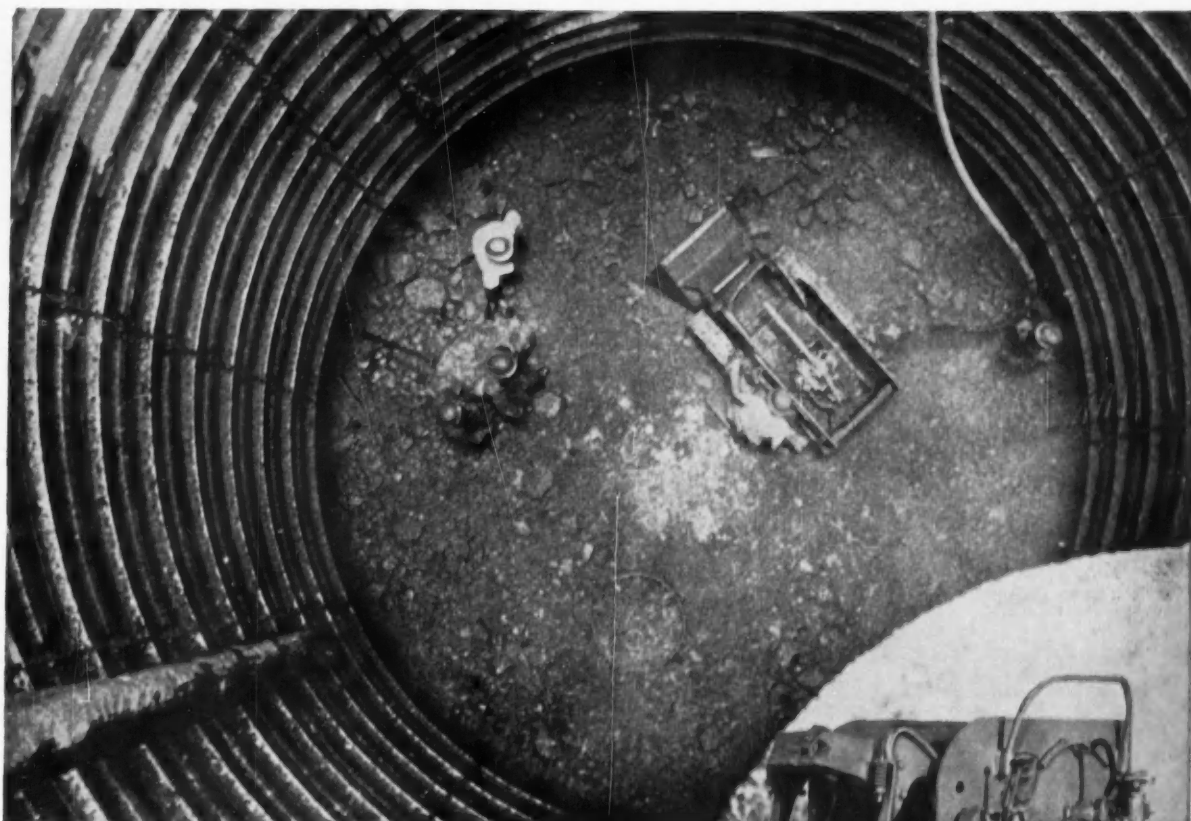
To connect the Coupling, you merely push the Plug into the Socket with one hand. Flow is instantaneous. To disconnect, push back sleeve on Socket — Coupling disconnects. Flow is shut off instantly and automatically.

WRITE FOR THE HANSEN CATALOG

Here's an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes and types of Hansen Quick-Connect Couplings. Write for your copy.



REPRESENTATIVES IN PRINCIPAL CITIES



MINERS USE EIMCOS WHERE PROFIT DEPENDS ON HIGH PRODUCTION

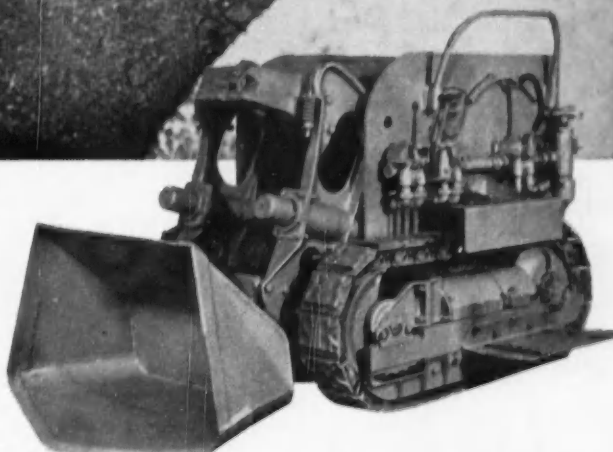
At exploration projects . . . and mucking low-grade ore where profit is realized only when high tonnage quotas are met — the Eimco 630 Crawler-Excavator is expanding production opportunities.

Increased demand for the versatile 630 by firms who previously were stymied in exploration and development projects because of tonnage requirements . . . is proof that Eimcos are helping to solve this production problem.

The 630 also is helping to recover large, low-grade ore bodies through exploration of deeper horizons. Areas that other underground development hasn't touched during years of continuous mining activity, are now worked profitably.

One important phase of these expansions is tough shaft sinking jobs. Often, occurrence of water adds to the already severe service conditions under which equipment must perform.

But as one superintendent put it, "We haven't had trouble digging the last feet of any wet shaft round with the Eimco and it really takes punishment."



Working in a 26 foot diameter shaft with mine-rail concrete lining . . . this Eimco 630 Crawler-Excavator is saving labor and maintenance costs while providing high tonnage production. Independent track maneuverability, operating ease and powerful, fast digging-loading ability makes the Eimco ideal for this application.

This is possible because the 6,000 lb. digging effort at the bucket lip gives the 630 tremendous crowding and digging power . . . enough to fill the big, half-yard bucket in any muck pile. And rugged construction with all vital parts protected against moisture and foreign material — insures long, on-the-job service.

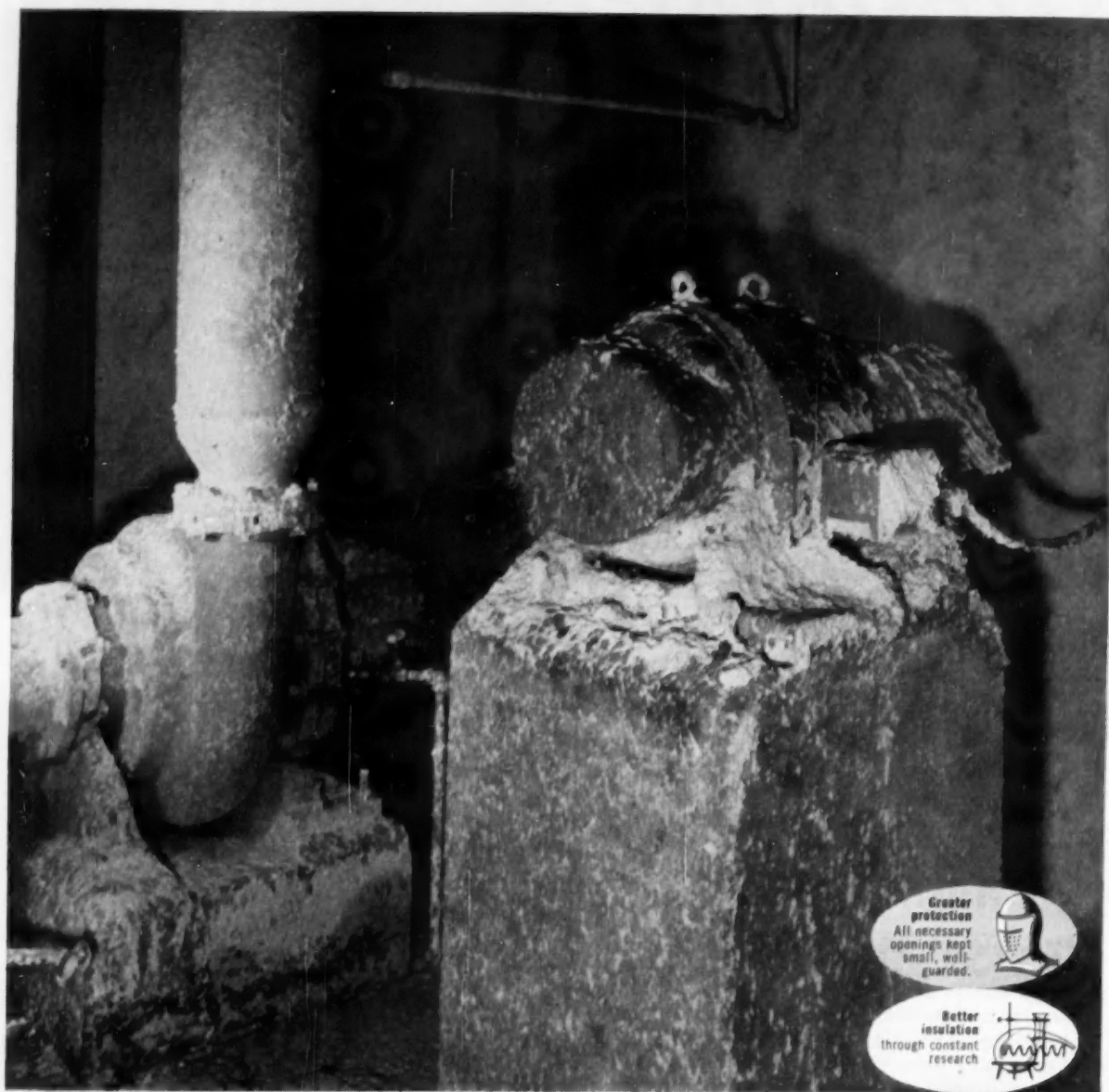
In any underground excavating job . . . the standard Eimco 630 will permit you to increase your earning potential without addition of specialized machinery. Write today for full information!

THE EIMCO CORPORATION
Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Pittsburgh, Pa. Seattle, Wash.
Cleveland, Ohio Houston, Tex. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa



B-360



Be glad you weren't working here...



But this sturdy Louis Allis motor was, and still is!

Shortly before this picture was taken, that pulp-mill pump suddenly ruptured. Blasted every object in the area with a thick coating of hot paper pulp.

But note the Louis Allis 20 HP splash-proof motor designed to take this kind of abuse — and come back for more! Note that it took the full force of this blast on its vented *underside* — a motor's most vulnerable point. Only a sturdy, well-designed motor could resist this. Still functioning perfectly this one didn't miss a beat!

Let us tell you more about Louis Allis electric motors. About such unique features as the new varnish of Gilsonite combined with phenolics and alkyds that provides the highest degree of moisture, acid, and alkali resistance . . . locked bearings that reduce end play and extend bearing life . . . the dynamically balanced rotor. And about the many other Louis Allis extras better discussed at length in our file-sized Reference Bulletin 1700. Why not write for it today? The Louis Allis Co., 437 East Stewart Street, Milwaukee 1, Wisconsin.

LA-111

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

LOUIS ALLIS



EIMCO 105 PRODUCTIVE VERSATILITY IN ACTION!

NEW! FRONT END LOADER

Here's the latest addition to the 105 wide-range family of rugged earth-moving tools.

In loading applications where physical and haulage conditions make its use more practical . . . here is a front end loading mechanism that gives you extra strength for the most severe job.

Bulldozer

Dozer blade attachments are designed to make full use of the extra-production features of the 105. In broad usages such as cutting haul roads for logging outfits . . . pioneering in shale and hard rock . . . clearing fire paths for the Forest Service . . . the Eimco 105 Bulldozer has proven its high-capacity ability the world over.



Large, double-acting hydraulic boom cylinders provide ample power to hoist loads weighing up to 15,000 lbs. to full height. Boom and bucket controls may be operated simultaneously.

To fill the big (2½ yard) bucket, this loader develops 25,000 lbs. digging force at the lip. 40,000 lb. pry-out force and 40 degree bucket tip-back at ground level gets full bucket loads, minimizes spillage. It carries loads close and low for maximum stability.

It operates in 9' 6" headroom . . . discharges into haulage units up to 14'.

Exclusive features of the hydraulic system provide an extra margin

All attachments are Eimco-built to standard SAE mounting dimensions for the basic 105 Tractor. This means extra performance from every attachment through independent track maneuverability . . . up front visibility . . . power shift operating ease . . . balanced design for maximum stability . . . quality built for dependable on-the-job service.

of protection against mechanical delays.

Excavating Loader

Where digging is extra tough . . . and haulage provisions can be adopted to take full advantage of overhead discharge — the time-proven 105 Excavating-Loader will give you **bonus** loading power at the bucket lip and **bonus** dumping speed to accelerate the entire cycle.

Unique contour of the rugged rocker arms . . . bucket design and smooth, steady flow of engine power transmitted to the bucket lip through the torque converter gets 39,200 lbs. of digging force right where you want it . . . in the pile. Awkward maneuvering to get into dumping position is eliminated in ideal overhead discharge applications.



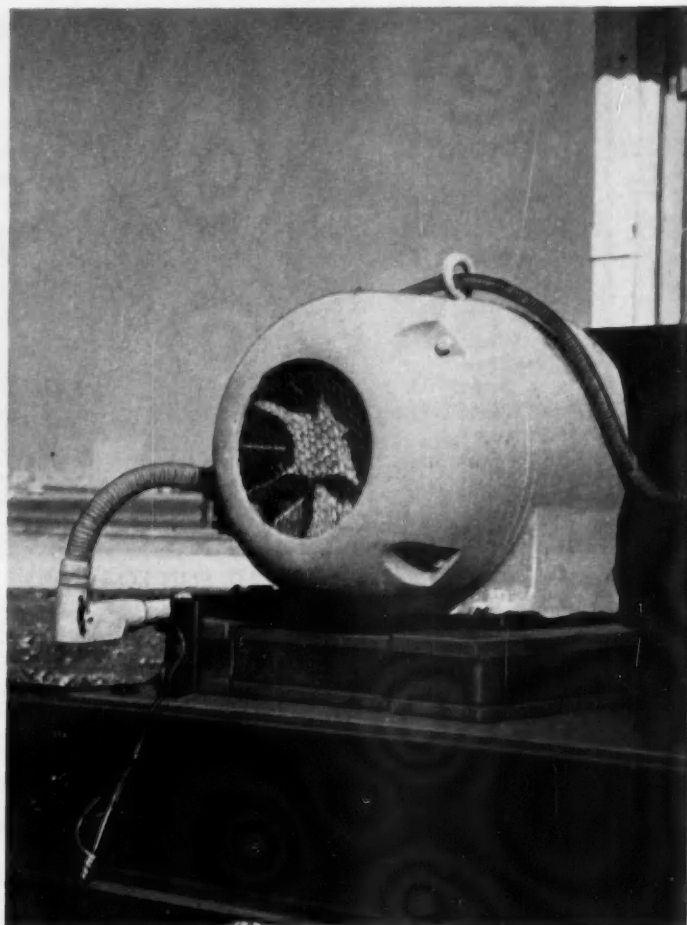
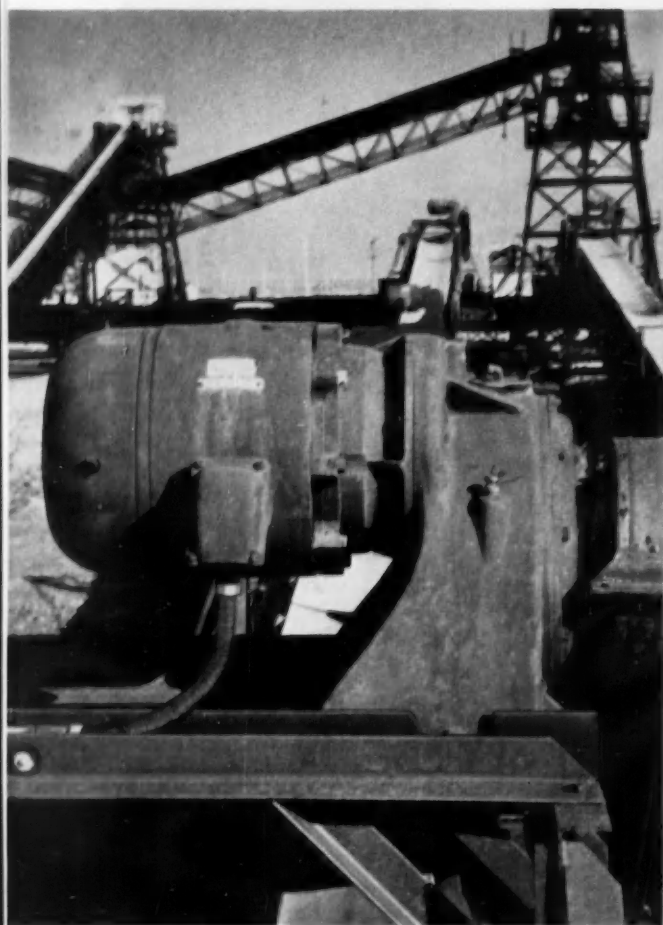
THE EIMCO CORPORATION
Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kelllogg, Ida. Pittsburgh, Pa. Seattle, Wash.
Cleveland, Ohio Houston, Tex. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

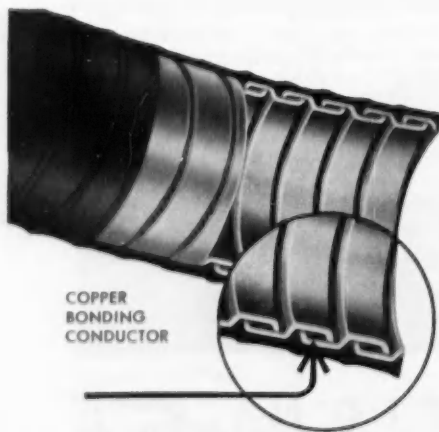


SALT COMPANY STOPS CONDUIT FAILURES

with Sealtite flexible, liquid-tight conduit



Dripping of wet salt and outdoor exposure has had no effect on Leslie Salt Company installation of Sealtite. Long life of this flexible, liquid-tight conduit cuts its over-all cost far below that of so-called less expensive conduit.



COPPER
BONDING
CONDUCTOR

Type U.A. Sealtite is approved by Underwriters' Laboratories for service in wet spots. Copper conductor wound spirally inside conduit for positive ground. Type E.F.† (not shown) is extra flexible. Meets J.I.C. standards. Available in machine tool gray at no extra cost from mill stocks.

"Corrosive conditions around our plant are so bad that it wasn't long before the BX conduit installed on our original equipment began to fail," reports Leslie Salt Company, San Francisco. "Wet salt ate through the metal and soon shorted out the circuits."

"Five years ago we decided to replace the BX with Sealtite*. Today, this Sealtite looks as good and is as flexible as it was the day it was put in—despite constant exposure to concentrated salt and the weather—both winter and summer."

Other manufacturers have told us the same story. And many use Sealtite, not only when a flexible conduit is required, but also to save money where corrosive conditions play rough with rigid conduit. For Sealtite's tough, extruded *polycynyl* outer jacket resists moisture, corrosive chemicals, oils and greases, rain and sun and just plain dirt.

Try Sealtite yourself!

Electrical wholesalers stock Types U.A. and E.F. in easy-to-handle coils. Buy Sealtite in coils and cut it on the job without waste. Special liquid-tight connectors by Appleton, Thomas & Betts, Gedney or Pyle-National are available. For complete information, write: The American Brass Company, American Metal Hose Division, Waterbury 20, Conn.

*Trade Mark. †Patent Applied For.

55105



Insist on the original

SEALTITE

FLEXIBLE, LIQUID-TIGHT CONDUIT

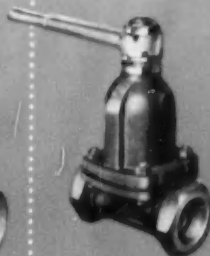
an **ANACONDA**® product

ALL-PURPOSE VALVE

for handling materials as diversified as corrosive fluids, gases, beverages, viscous materials, foods, compressed air, solids in suspension.



Handwheel Operated



Lever Operated



Power Operated

Grinnell-Saunders Diaphragm Valve

Unsurpassed on lines where corrosion, abrasion, contamination, clogging, leakage and maintenance are costly factors.

In industries as varied as mining, food, textile, pulp and paper, beverage, water and sewage, chemicals . . . Grinnell-Saunders Diaphragm Valves continue to win enthusiastic acceptance. The unique design of the valve — with its flexible, long-wearing, tight-closing diaphragm — offers many unusual advantages.

If you have a valve problem, it will pay you to write Grinnell for further information.

GRINNELL

WHENEVER PIPING IS INVOLVED

Choice of Materials

Bodies — iron; cast steel; stainless steel; Durimet 20; Hastelloy A, B, C; bronze; Monel; aluminum; PVC (polyvinyl chloride); Saran

Body linings — hard rubber; soft rubber; neoprene; glass; lead; plastics; Heresite; Lithcote

Diaphragms — soft natural rubber; natural rubber; white synthetic rubber; neoprene; reinforced neoprene; butyl; Hycar; Teflon; Kel-F; PVC (polyvinyl chloride); polyethylene

Bonnets — iron; stainless steel; bronze; other materials on special order

Choice of Bodies

Conventional weir type

Straight bodies — screwed; flanged; socket weld; butt weld; socket (solder); sanitary threads; hose ends; Victaulic

Angle bodies — screwed; flanged; socket weld

Other types

A line of Straightway Valves (for straight-thru flow) and Full-Bore Valves (for ball brush cleaning) also are available

Choice of Bonnets

Handwheel (non-indicating stem, indicating stem); chain wheel; lever (for quick operation); sliding stem (for a wide selection of power operated topworks)

Operating Features

- diaphragm absolutely isolates bonnet mechanism from the fluid in the line

- diaphragm lifts high for streamline flow in either direction

- diaphragm presses tight for positive closure

- simple maintenance — diaphragm easily replaced without removing valve body from line



OPEN



CLOSED



Grinnell Company, Inc., Providence, Rhode Island

Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

MARCH 1957

Circle 9A on reply card

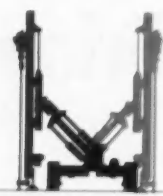
Circle 10A on reply card

ADV. 11

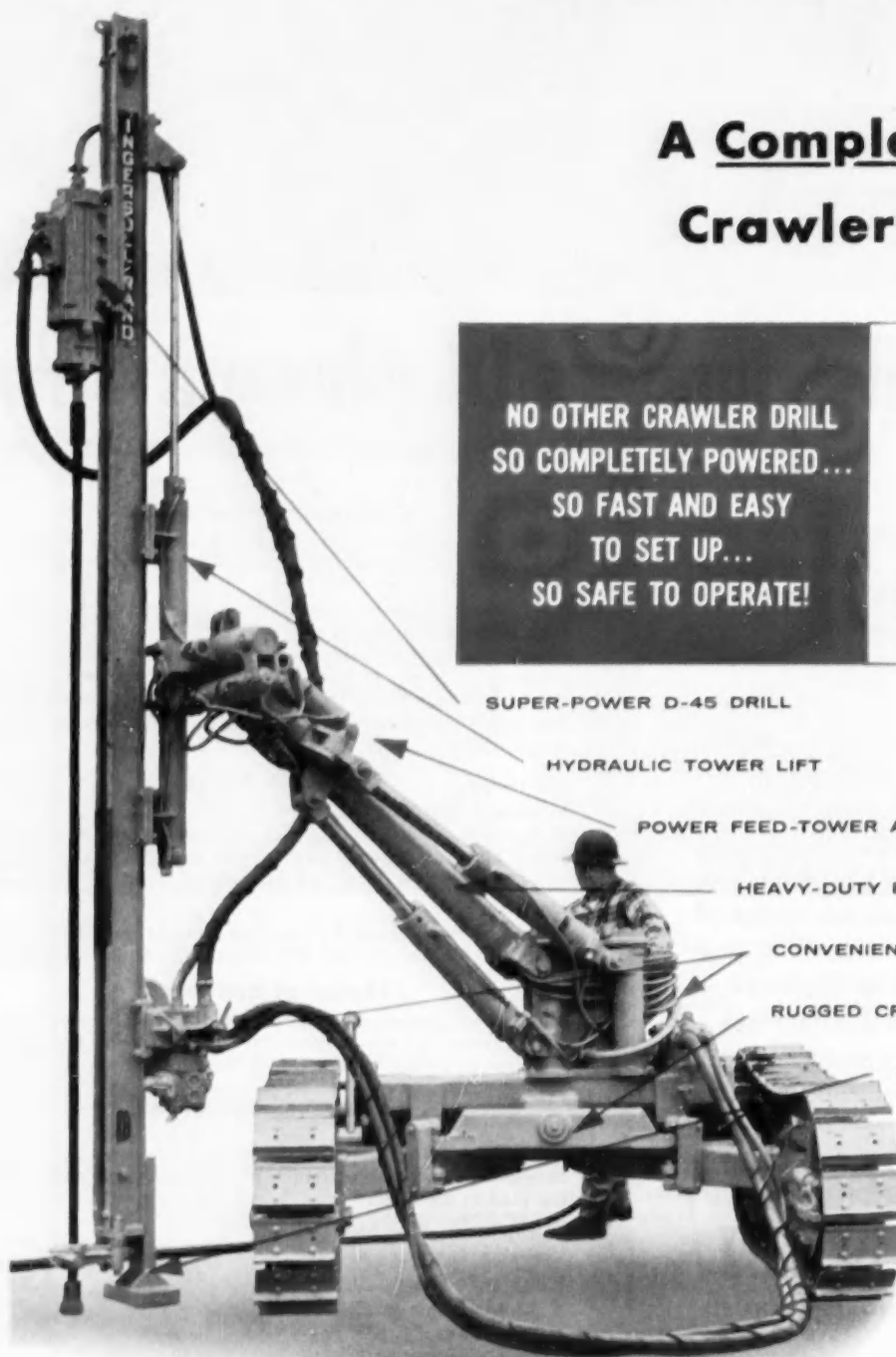
Announcing the

A Completely New, Crawler Drill at its

NO OTHER CRAWLER DRILL
SO COMPLETELY POWERED...
SO FAST AND EASY
TO SET UP...
SO SAFE TO OPERATE!



1. Hydraulic Boom Swing of 9°11' gives maximum usable hole pattern with a single crawler setup and permits line hole drilling along a face over the tracks.



SUPER-POWER D-45 DRILL

HYDRAULIC TOWER LIFT

POWER FEED-TOWER ADJUSTMENT (5 ways)

HEAVY-DUTY BOOM

CONVENIENT CONTROLS

RUGGED CRAWLER ASSEMBLY

FEED-TOWER FOOT PAD

MAXIMUM FLEXIBILITY
WITH
COMPLETE SAFETY

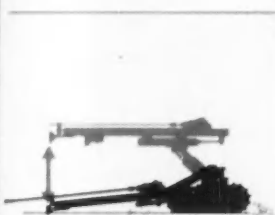
FOR A PACE-SETTING DRILLING COMBINATION,

C

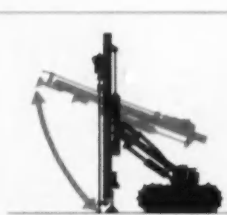
Ingersoll-Rand

CRAWL-IR

Completely Mechanized **RUGGED BEST!**



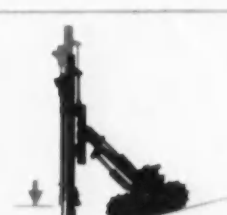
2. Hydraulic Boom Lift
raises and lowers booms in vertical plane—covers distance of 7'3" with tower in horizontal position.



3. Hydraulic Feed-Tower Tilt
sets feed tower at any angle.



4. Hydraulic Feed-Tower Swing
sets tower for vertical drilling on any slope—or positions drill for horizontal holes at any angle to crawler travel.



5. Hydraulic Feed-Tower Lift
slides feed tower up or down, in or out—permitting foot pad to be set firmly on the ground.

HERE, in one unit, is a completely mechanized and self-propelled heavy-duty crawler drill that will greatly expand the scope of Wagon Drill operations. With *all* boom and feed-tower adjustments hydraulically controlled, you can make faster, safer and easier setups for drilling in *any position*. And because the CRAWL-IR can tow its own portable compressor, you save manpower and release auxiliary equipment generally required to move drills and compressors on the job.

The following advantages and features make this the fastest-acting, easiest drilling and safest unit of its type ever developed. It can be supplied with percussion or rotary drills, and with a wide range of optional hydraulic combinations when all of the power features are not required. Ask your I-R representative for complete information on this new self-propelled blast hole drill—or send for a copy of Bulletin No. 4189.

ADVANTAGES

SELF-PROPELLED — The CRAWL-IR is powered by two independently controlled heavy-duty piston type I-R air motors. Knee-action frame construction permits these motors to take the crawler over rugged terrain.

SPEEDS SETUPS — Five hydraulic cylinders quickly and safely position and lock the feed-tower in position by manipulation of convenient controls located on the boom base.

FAST STEEL HANDLING — Reverse rotation in the powerful D-45 drill when used with coupled steel provides a convenient and easy method of adding and removing steels in a hurry. The D-45 also incorporates release rotation which permits hammer action on the steel for loosening joints and fighting stuck steels.

MORE DRILLING TIME — The bulk of the time formerly spent on conventional Wagon Drills in moving, hand wrench time and steel handling is now turned into drilling time. With the drill positioning completely mechanized one man operation is entirely feasible.

Ingersoll-Rand

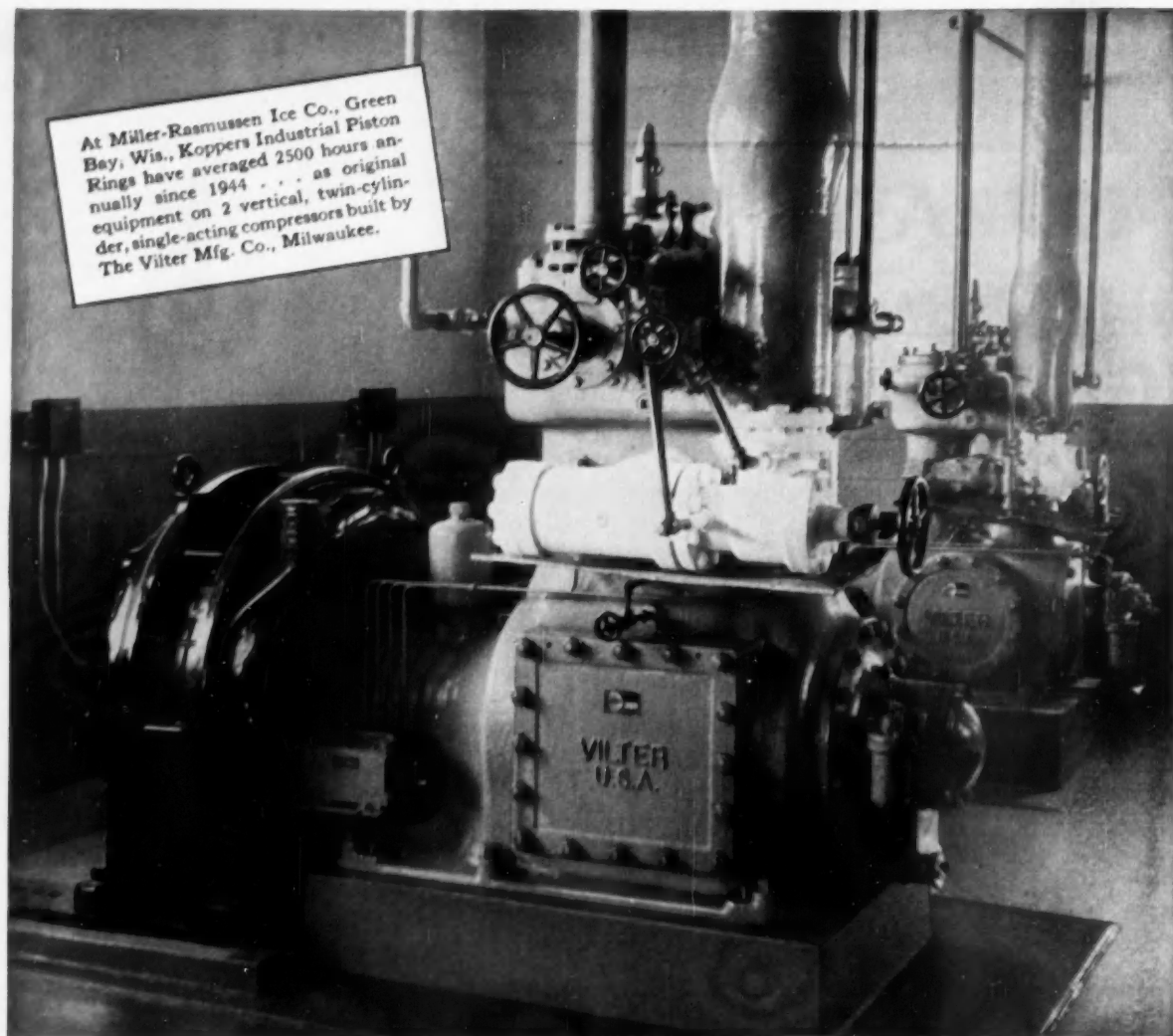
11 Broadway, New York 4, N. Y.



5-515

POWER THE **CRAWL-IR** WITH A **GYRO-FLO** COMPRESSOR

At Miller-Rasmussen Ice Co., Green Bay, Wis., Koppers Industrial Piston Rings have averaged 2500 hours annually since 1944 . . . as original equipment on 2 vertical, twin-cylinder, single-acting compressors built by The Vilter Mfg. Co., Milwaukee.



Koppers Piston Rings go 10 years without repair, replacement or oil waste!

Like Miller-Rasmussen Ice Co., you can reduce maintenance costs and time and increase operating efficiency with Koppers Industrial Piston Rings. You can profit from longer piston ring life . . . longer cylinder life . . . and eliminate piston ring feather, scoring and scuffing.

Koppers American Hammered Industrial Piston Rings prolong the lives of Diesel, gas, aircraft, gasoline and many other engines, valves and compressors. Rings range in diameter from 1 inch to 10 feet . . . are of cast iron and special alloy cast irons;

they may be chromium-plated for added durability.

Our field engineers in your area will be glad to unravel your knottiest piston ring problems and help provide you with a new high in piston ring performance. They'll check your present piston rings in operation . . . recommend the proper ring type . . . or even have a ring designed for your specific application.

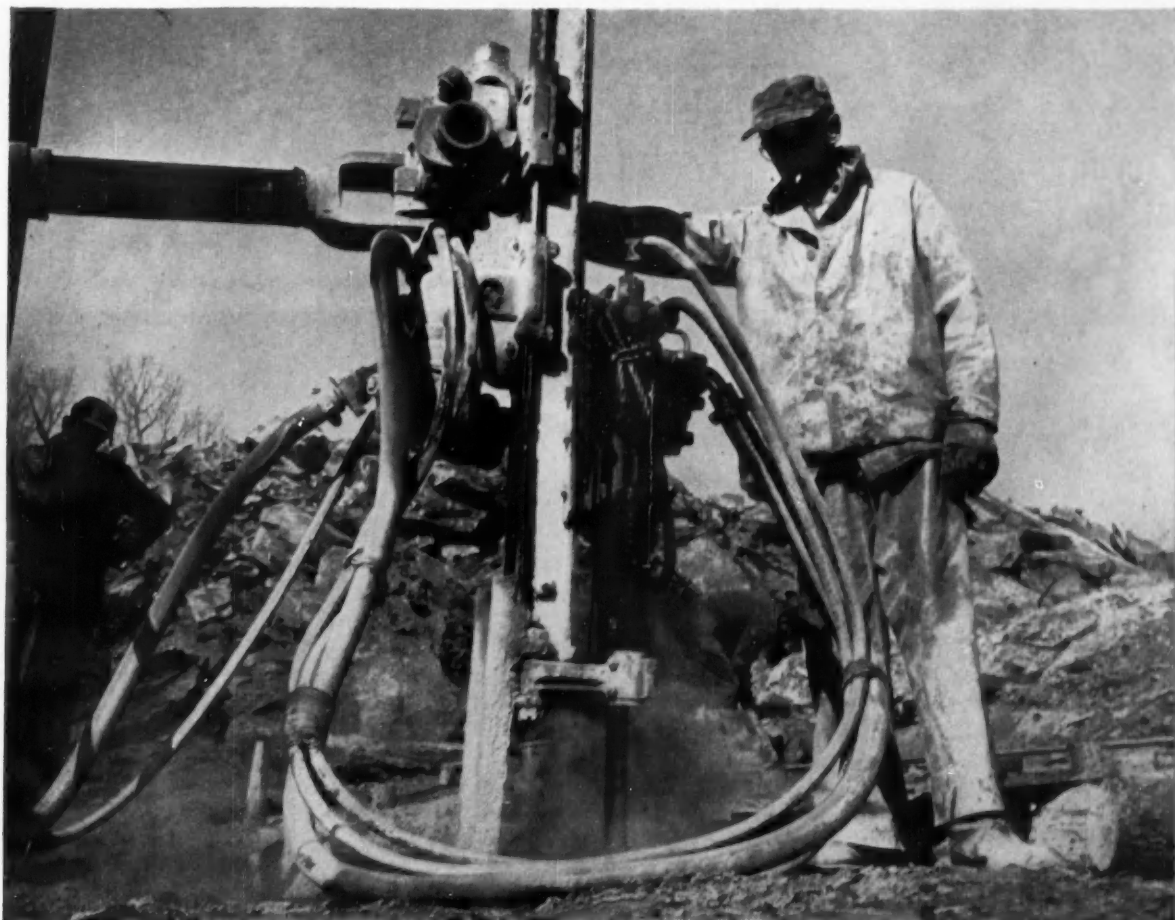
Bring your piston ring problems to Koppers. Phone or write: KOPPERS COMPANY, INC., *Piston Ring and Seal Dept.*, 1603 Scott St., Balto. 3, Md.

Koppers Company, Inc.
Metal Products Division
Piston Ring and Seal Dept.

Engineered Products
Sold with Service



AMERICAN HAMMERED
Industrial Piston Rings



Bethlehem Hollow digs into medium-hard rock at Dow Air Field, Bangor, Me. Contractor: J. R. Clanchette Construction Co., Bangor. The drill steel was reconditioned by Bicknell Manufacturing Co., Rockland, Me.

Rock-Removal for Air Base Runway

Because the existing runways at Dow Air Field, Bangor, Maine, were not long enough to accommodate some of the heavier types of military aircraft, the U. S. Air Force recently decided to construct a new runway, with the work being done by the Army Engineers. Bethlehem Hollow Drill Steel was used exclusively in making the blast holes.

The project called for the removal of a hill, containing about 500,000 cu yd of medium hard rock. This was accomplished by drilling 24-ft blast holes with 1¼ in. and 1½ in. round Bethlehem Hollow, fitted with carbide-insert bits, and mounted in jackhammers and drifters. The performance of the drill steel was excellent.

Bethlehem Hollow provides dependable service in just about any type of rock-removal operation you can name. Here's why: It's rolled from tough

fatigue-resisting steel. It has a wide quenching range, which makes it easy to heat-treat for the proper balance of toughness and wear-resistance. Moreover, it always provides long-wearing threads and strong shanks.

ALL STYLES AND LENGTHS

Bethlehem Hollow is produced in two grades, carbon and ultra-alloy, in rounds, hexagons and quarter-octagons. It is furnished regularly in popular lengths of from 18 ft to 25 ft. For holes of special depth, longer lengths can be supplied. When you talk with your converter, tell him you want Bethlehem Hollow on your next drilling job.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

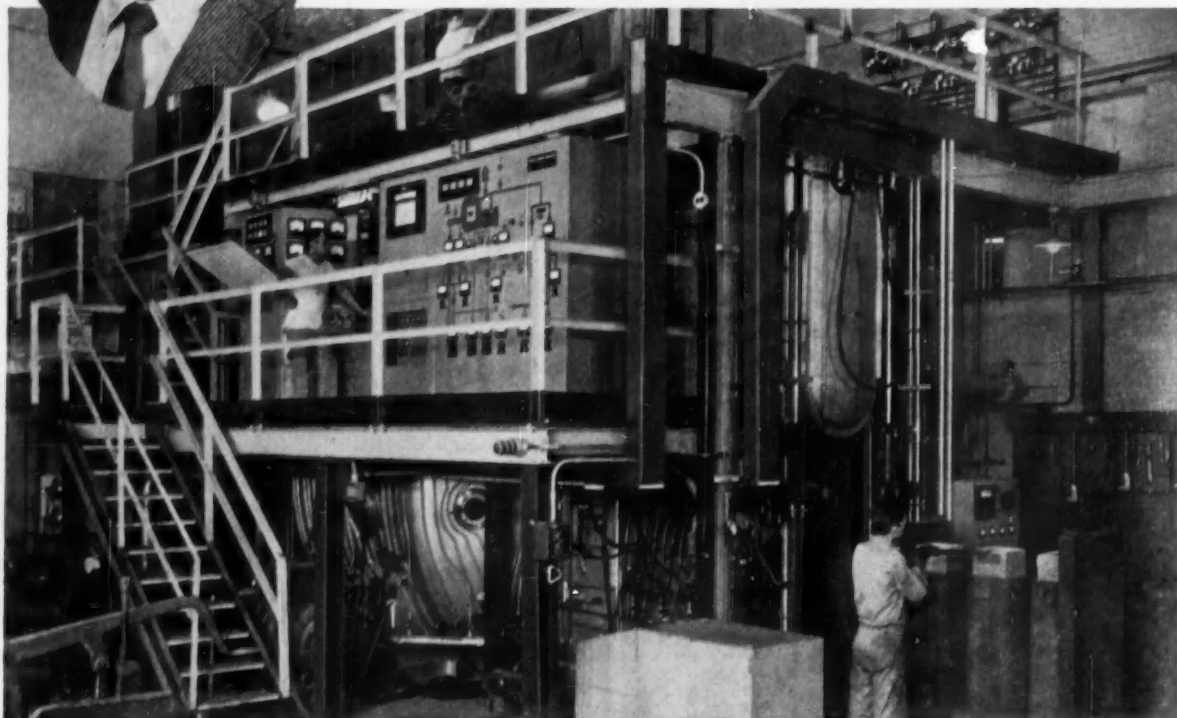


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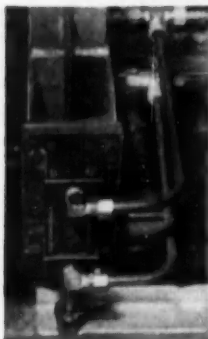


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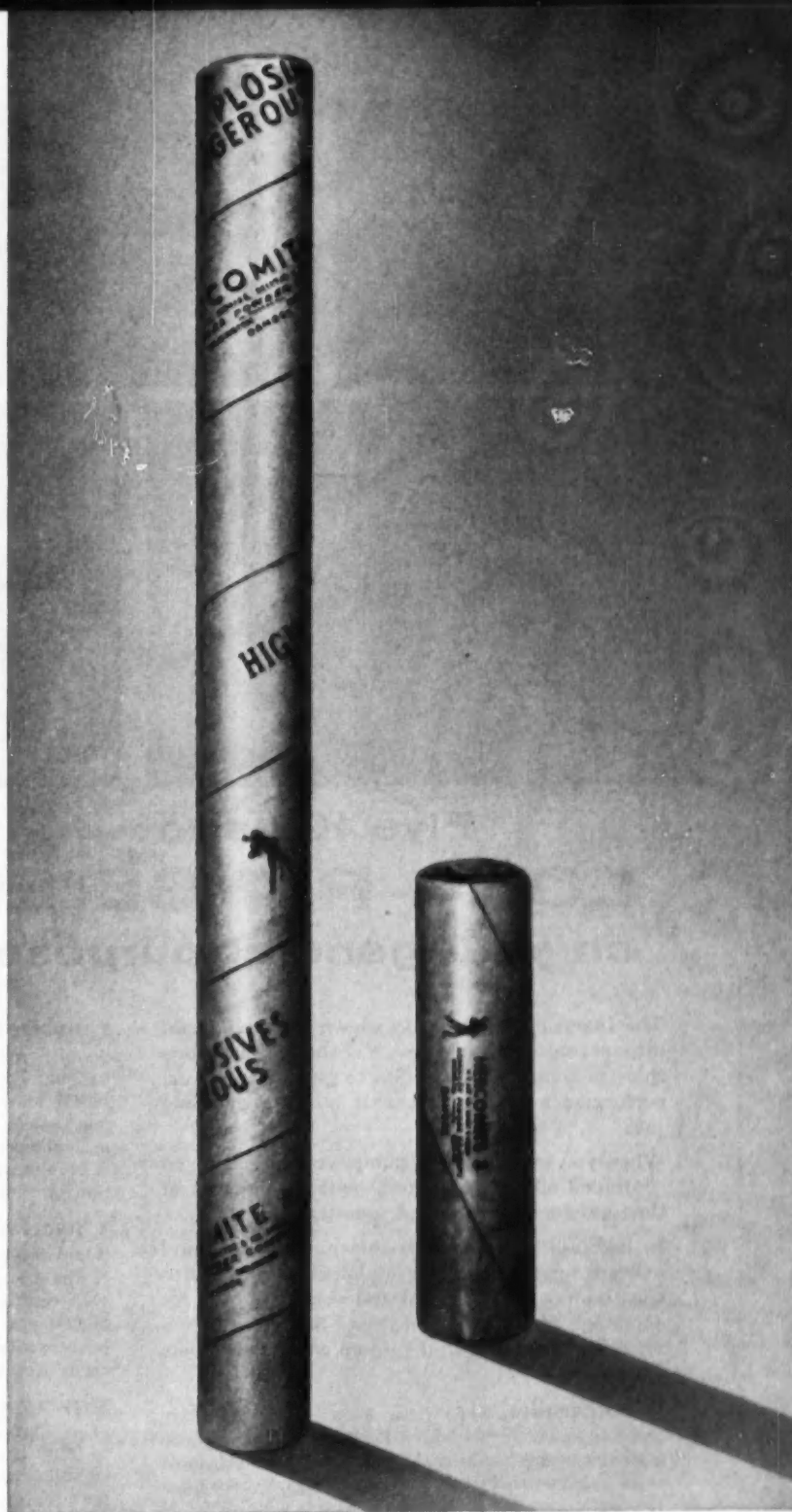
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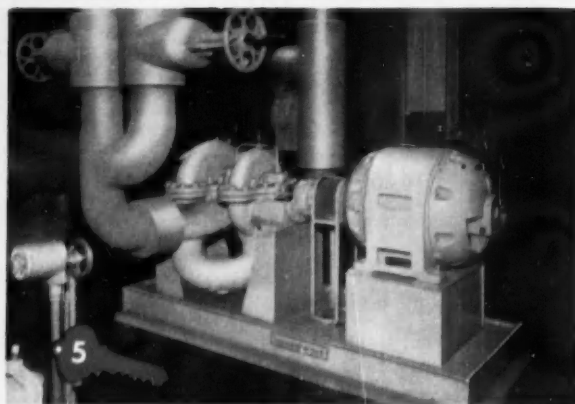
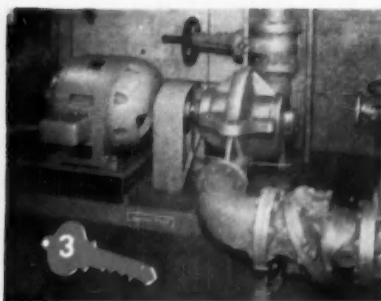
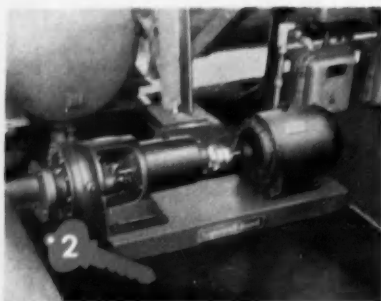
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ON THE COVER

WHEN Tri-Dam Constructors tackled the construction of Donnell's Dam, in California's rugged High Sierras, it was faced with two problems. First, it had to build roads to get men, materials and equipment into the site and, next, it had to establish footholds in the precipitous terrain from which to work. Our cover picture was taken looking upstream toward the dam site, which is around the bend, directly below the carriage of the aerial tramway built to transport concrete to the dam from a mixing plant perched high on the right cliff and not shown here. In the right and left foreground, are banks of spoil excavated from tunnels and the riverbed. The access roadway high on the right slope marks the level of the dam spillway, for which some concrete had already been poured. Shop buildings may be seen on ledges at the right center.

IN THIS ISSUE

IN THE arid sections of the West, the battle for water grows sterner year by year and is intensified by the rapid growth in population. The Tri-Dam Project, subject of our first article, represents the culmination of long and persistent efforts by two fairly small California irrigation districts to procure additional water for croplands. As its name implies, the project calls for the construction of three dams—Donnell's, Beardsley and Tulloch—on the Stanislaus River and its principal tributary. To defray the cost of the storage facilities, power will be generated at all three locations and sold to a utility company. Despite difficult topographical conditions, excellent progress is being made by the contractors.

WHEN handled properly, compressed air is a safe medium of power—ready and willing at the turn of a valve to serve man's needs in countless ways. Like steam or electricity, it must be treated with respect and common sense. Manufacturers of compressed-air systems and tools build into them all possible safeguards and also issue instructions for proper procedure and handling. Some general safety pointers that will, if followed, also increase compressor-plant efficiency are set forth in the article that starts on page 74.

CORRECTION

ONE wrong letter in a caption on page 44 of our February issue made The Borden Company seem much smaller than it really is. The firm's annual sales are well over three-fourths of a billion dollars, not million, as was stated.

Compressed Air Magazine

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VOLUME 62

March 1957

NUMBER 3

G. W. MORRISON, *Publisher*

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Published by Compressed Air Magazine Co., G. W. MORRISON, *President*
C. H. VIVIAN, *Vice-President* A. W. LOOMIS, *Vice-President*
J. W. YOUNG, *Secretary-Treasurer*
Editorial, advertising, and publication offices, Phillipsburg, N. J.
New York City Office, 11 Broadway, L. H. GEYER, *Representative*
Annual subscription: U.S., \$3.00, foreign, \$3.50. Single copies, 35 cents.
COMPRESSED AIR MAGAZINE is on file in many libraries and is indexed in Industrial Arts Index and in Engineering Index.



PHOTO FROM MORRISON-KNUDSEN CO., INC.

DONNELLS ARCH

Looking down on narrow structure rising in steep Sierra canyon. The contractor expects to complete it next fall, many months ahead of schedule.

A LONG the Stanislaus River, on the western slope of the High Sierras of Central California, construction crews are busy at three locations creating what is known as the Tri-Dam Project. Despite its estimated cost of \$52 million, this is not a Government undertaking but is, on the contrary, sponsored by two groups of private citizens and not very large groups at that. They are the Oakdale Irrigation District and the South San Joaquin Irrigation District. The forty-niners panned gold along the Stanislaus, but the treasure sought now is water, which means more to the Far West today than precious metal.

The scheme calls for providing facilities to collect and store water during the times of greatest runoff so that it can be released and distributed to downstream agricultural lands in the San Joaquin Valley during the late growing season when crops need more moisture than

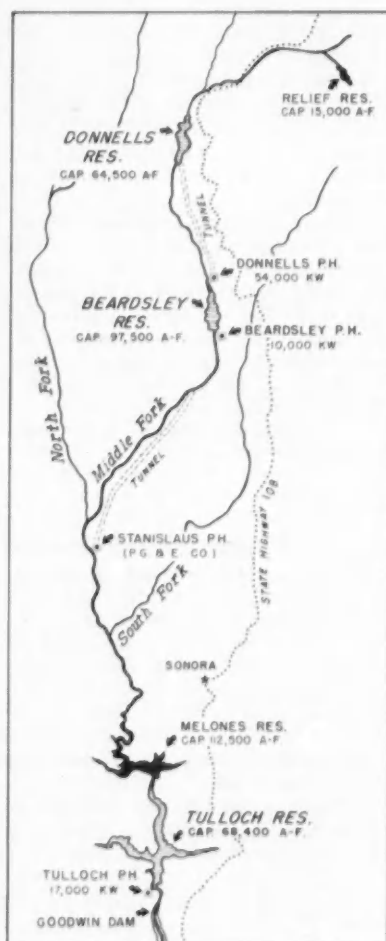
they now get. To accomplish this objective, three dams are being erected and an existing one is being heightened. In order to pay for the construction, the familiar Government formula of generating power is being followed. Hydroelectric plants with aggregate capacity of 81,000 kw will be operated by the districts and the power sold to Pacific Gas & Electric Company under a 50-year contract.

Two of the dams, Donnell's and Beardsley, known as the upper works, are being reared on the middle fork of the Stanislaus, not far from the summer resort town of Strawberry. Downstream on the river's main course Tulloch Dam is taking form and the existing Goodwin Dam below it is being raised slightly to serve as an afterbay for stabilizing the flow. All of the construction lies roughly between the towns of Sonora and Strawberry, which are about 60 miles apart. The three new reservoirs will provide

TRI-DAM PROJECT

Two-California Irrigation Districts Carrying Out \$52-million Development on Stanislaus River

ALLEN S. PARK



PLAN OF PROJECT

A century ago this section was dug up by goldseekers intent on taking away nature's treasure. Today's diggers are conserving the West's greatest resource—water.

storage for 230,400 acre-feet of water and this, together with 112,500 acre-feet already available in Melones Reservoir that the districts built in 1926, will be sufficient to insure ample irrigation of the acreage concerned in normal years and also to hold over enough to meet the demand in unusually dry years.

Means of providing the additional water needed were under consideration for many years. By 1952 it had been pretty well decided how the storage could be effected, but the knotty problem of how the construction would be paid for had not been solved. Various avenues were explored and eventually the idea of footing the bill with power revenues was advanced. Upon being approached, P G & E agreed to purchase the power for feeding into its transmission system, but in order to negotiate a contract to bring this about, it was necessary for the district to make a study of expected runoff of the watershed, rate structures, state regulations, etc. The required engineering works for generating facilities were incorporated in the plans and specifications and bids were then asked for in order to determine the cost of construction so that the size of bond issue required could be known. After the bids had been opened, it appeared that an issue of \$52 million would suffice and that sum was accordingly authorized. When the California legislature passed an act in May 1953 permitting savings banks to invest in the bonds it looked as though clear sailing

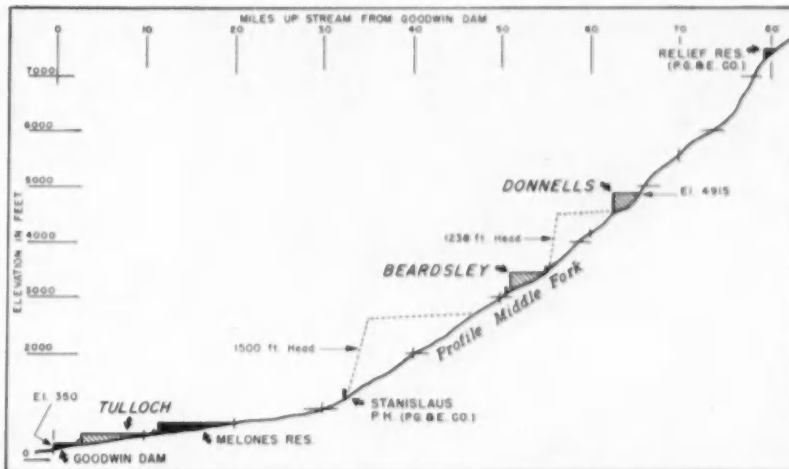


DIAGRAM SHOWING RELATION OF STRUCTURES

The stream drops 4565 feet in the 60 miles between Donnell's and Goodwin dams.

were ahead, but conditions in the bond market were unfavorable and the best offer received for the bonds fell short of the sum needed for the construction program. Bids consequently had to be rejected and there followed another year of study aimed at finding a way to provide additional funds. A bill was even introduced in the United States Congress designed to empower the Government to extend a loan which would have been paid back from power revenues, but it never came to a vote.

In 1955 it was decided to carry out the

construction in two stages, i.e., to begin work immediately on the upstream Donnell's and Beardsley dams and their appurtenant works and delay the remainder of the program until the bond market had improved. This seemed to be the logical procedure in view of the fact that these upper structures represented 78.7 percent of the total project cost and would bring in 86.3 percent of the power revenue. It was not desirable, however, from the standpoint that the downstream works would contribute most importantly to the irrigation benefits.

Pursuant to this plan, bids were asked on the upstream construction early in 1955 and on May 25 a \$31,199,850 contract was let to Tri-Dam Constructors. This is a joint-venture firm made up of Morrison-Knudsen Company, Inc., Boise, Idaho, which is the sponsor; Peter Kiewit Sons' Co., of Omaha, Neb.; Macco Corporation of Paramount, Calif.; and Stolte, Inc., of Oakland, Calif. Within a few months, conditions permitted letting a contract for the downstream works and this was done on November 30, 1955. The successful bidder was The Arundel Corporation, of Baltimore, Md., and L.E. Dixon Company (sponsor), of San Gabriel, Calif., and the amount was \$8,291,438.

Donnell's Dam, uppermost of the chain of structures and the most important of the group for power production, is a concrete arch with a gate-controlled overflow spillway on the left abutment. At its site the stream flows through a narrow canyon or gorge on top of deposits of loose material approximately 200 feet thick. The dam is in effect to be a narrow and slender plug that will have a height above bedrock of 477 feet, of which only 290 feet will rise to view above the streambed. It will be 960 feet long over-all, 41 feet thick at the base and 10 feet at the crest and contain 175,000 cubic yards of concrete. The watershed



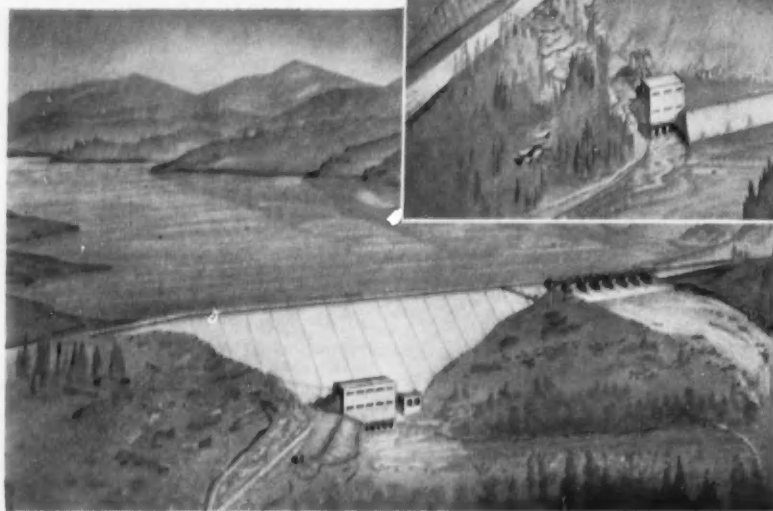
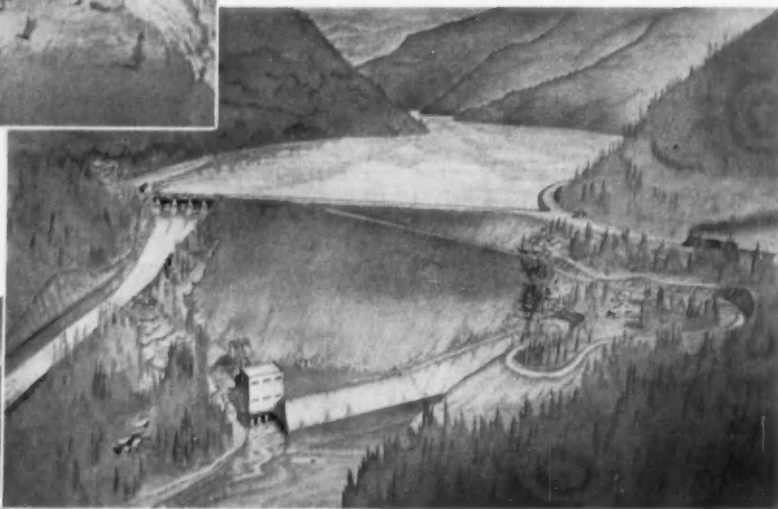
BUILDING ACCESS ROAD

Carving access roads into Donnell's and Beardsley dam sites was a sizable construction chore in itself. All of the equipment and supplies needed for the main work in the canyon, including 2000 truckloads of cement, has to be hauled in over these roads. A crew is shown drilling with jackhammers powered by air from the L-R portable compressor at the left.



DONNELLS DAM (left) will be a thin concrete arch 960 feet long at the crest, with a gate-controlled spillway at one side. It will rise 477 feet from bedrock, but about 40 percent of it will be in the ground, hidden from view. The site is a narrow gorge in which the water will be backed up 3 miles, forming a reservoir with 64,500 acre-feet of storage capacity. Most of the impounded water will be delivered to a downstream 54,000-kw powerhouse through a 7.1-mile pressure tunnel and a connecting penstock.

BEARDSLEY DAM (below), 12 miles downstream from Donnell, is to be an earth-and-rock-fill structure with a gated spillway on one abutment and a powerhouse of 10,000-kw capacity at its base. A logging railroad in the reservoir area is being relocated to run across the 1000-foot-long crest. Rising 320 feet (280 feet above the streambed), the dam will contain about 3 million cubic yards of material. Its reservoir will hold 97,500 acre-feet of water which, at full level, will back up to the Donnell powerhouse.



TULLOCH DAM, about 45 miles downstream from Beardsley, will be a concrete gravity structure 1600 feet long, with a gate-controlled spillway on one abutment. It will rise 200 feet above bedrock and 165 feet above the streambed. Two 114-inch-diameter penstocks will deliver impounded water to a 17,000-kw powerhouse at the foot of the dam. The reservoir will be 7 miles long at full level and hold 68,400 acre-feet of water. Goodwin Dam, just downstream, will divert water into the irrigation canal system.

above the site has an area of 224 square miles and the average annual runoff is 300,000 acre-feet. The reservoir will be 3 miles long, cover 425 acres at full-pool level and provide storage for 64,500 acre-feet of water.

From the reservoir a 7.14-mile tunnel will extend downstream and from its lower end a steel penstock 81 inches in external diameter and 2600 feet long will drop the water 1200 feet to the powerhouse where it will spin a turbine driving

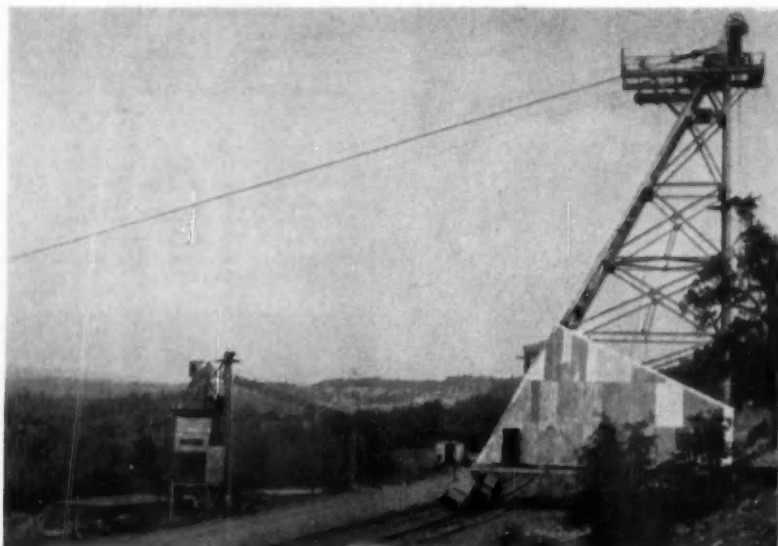
a 54,000-kw generator operating under a total maximum head of 1481 feet. Most of the water from Donnell's Reservoir will follow this course, but a low-level outlet pipe will carry enough flow to the stream below to preserve fish life. The spillway will be used only when the inflow to the reservoir is excessive.

Beardsley Dam, located approximately 12 miles downstream from Donnell, will be an earth-filled structure of 3,500,000 cubic yards with an impervious core.

It will be 1000 feet long at the crest, of which 220 feet will be a concrete spillway at the north abutment surmounted by four gates. From a thickness of 1200 feet at the base, the structure will narrow to 30 feet at the crest, which will be used as a crossing by the Pickering logging railroad, of which approximately 7 miles is being relocated to remove it from the reservoir area.

Rising 320 feet above bedrock and 280 feet above the streambed, the dam will back the water up 3 miles to the tailrace of the Donnell's powerhouse and will be the big water-catcher of the project. When full the reservoir will have an area of 720 acres and store 97,500 acre-feet of water. Immediately downstream from Beardsley Dam will be a powerhouse containing one 10,000-kw generating unit that will operate under a maximum head of 264 feet. A mile downstream a timber-crib-and-rock afterbay dam is being erected to regulate the fluctuating discharge from the reservoir.

Tulloch Dam, about 45 miles downstream from Beardsley, is located on the main Stanislaus River approximately 16 miles east of the town of Oakdale. Its function will be to stabilize the flow of the river by storing any excess water that



CABLEWAY TOWER AND AGGREGATE PLANT

The 8-ton-capacity cableway used for transporting concrete at Donnells Dam has a span of 1100 feet. One tower (left) moves on 700 feet of curved, banked rails and the other one, across the canyon, is stationary. The head tower was used as the tail tower of the cableways at Shasta and Hungry Horse dams. The main cable is 3 inches in diameter. Concrete is handled in 4-ton buckets that are moved from the mixing plant to the cableway loading station on a 1200-foot railway. The plant used for making aggregate and sand from quarried granite (below) clings to the steep hillside.

passes the upper works. The drainage area of the Stanislaus and its tributaries above this point is 987 square miles and the available runoff averages 1,000,000 acre-feet annually. The dam will be a concrete gravity structure of 230,000 cubic yards, 1600 feet long and 200 feet high. It will be 165 feet thick at the base and taper to 12 feet at the crest. A gate-controlled spillway located on the left abutment will discharge excess flow, but water will normally pass through two 114-inch diameter penstocks to the powerhouse or through two 6-foot-diameter steel outlet pipes to preserve downstream flow. The reservoir will be 7 miles long at full level, cover 1260 acres and impound 68,400 acre-feet of water. The powerhouse will contain two generating units with combined capacity of 17,000 kw and they will operate under a maximum head of 149 feet.

In addition to building Tulloch Dam, the contract calls for adding 7 feet to the crest of Goodwin Dam, built in 1916 and located just downstream. It is a concrete arch that will provide an after-bay for Tulloch powerhouse and which also diverts water into the distribution canals of the irrigation systems that are sponsoring the Tri-Dam construction program. The gate structure of the dam will also be improved.

The ruggedness of the country complicated the problem of getting started on the upper dams. The *Em-Kayan*, Morrison-Knudsen's monthly publication, sums up the adverse conditions in the phrase, "Here is a job that ranks among the toughest." No access roads worthy of the name existed; all had to be built. All told, Tri-Dam Constructors drilled, blasted and bulldozed 22 miles of them, including an 8.3-mile link between Donnells Dam and Donnells campsite to facilitate the free movement of men and materials. It was cut as a shelf from the



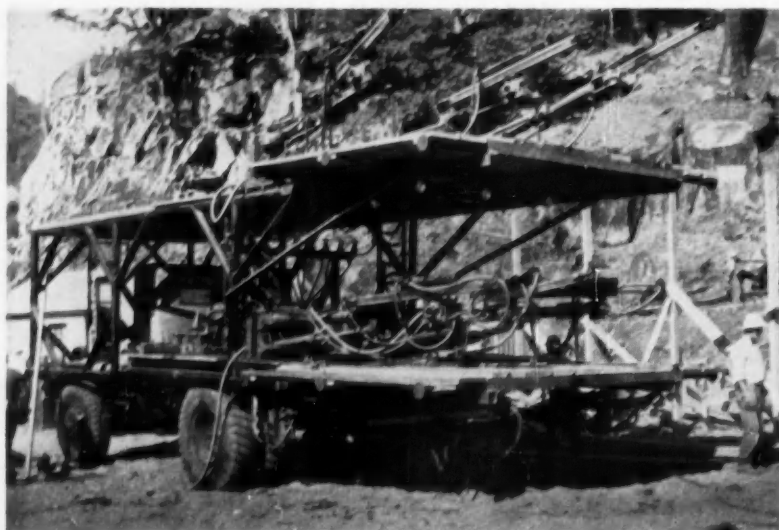
granite of the steeply sloping canyon wall. As all materials and supplies have to be trucked in as much as 50 miles from the nearest railroad and up to 5000 feet elevation, it was important that the roads be suitable for fast, all-weather haulage. They were built accordingly at a cost of \$500,000 and 5 months of effort. The contractor's bid also included an item of \$400,000 for providing a construction camp and another one of \$1,500,000 for setting up a concrete plant. The camp, located several miles downstream from Donnells dam site, includes dormitories for 250 men, room for house trailers and a mess hall that seats 175. Men are transported from the camp to Donnells dam site by bus or can drive their own cars. The contractor's main warehouse is also located at the camp. Beardsley Dam has its own camp.

There was no place for a concrete plant at Donnells except on the steep hillside and storage place for aggregates is at a premium. Consequently, it is necessary to keep the chain of processing operations going without a break if there

is to be no interruption of the concrete pouring schedule.

Aggregates and sand are made from granite that is quarried from a ridge 600 feet above the riverbed and upstream from Donnells Dam. The broken rock is trucked to a jaw crusher, the output of which is chuted by gravity to a 4000-ton live-storage pile with a tunnel underneath it for easy withdrawal of material. Four sizes of stone are prepared by screening and further crushing and sand is produced from the fines in a Marcy rod mill. Aggregates and sand are stored in five steel bins.

The concrete mixing plant is a C.S. Johnson fully automatic unit containing two Koehring 4-yard mixers. It has a capacity of 120 cubic yards per hour and will turn out the 220,000 cubic yards needed for the dam, powerhouse and tunnel at Donnells. A Lidgerwood 35-ton aerial cableway with a span of 1100 feet delivers concrete to the Donnells Dam construction area. It has a traveling head tower on the south canyon wall and a stationary tail tower on the north



DRIVING TUNNEL

Two-platform, 3-deck, truck-mounted drill carriages such as the one shown at the left were employed for driving Donnell and Beardsley diversion tunnels. Each carried 8 Ingersoll-Rand DB-35 drifters on Hydra-Booms. Three single-platform, 2-deck, rail-truck jumbos mounting 5 or 6 DB-35's on Hydra-Booms were used to drive the 7.1-mile Donnell power tunnel. One of the drillers is shown below at a heading. The view in the center shows a work train outside the portal of the discharge end of the power tunnel.

wall. A suspension footbridge 200 feet above the stream was erected to reach the north anchorage.

The first job undertaken after equipment had been trucked to the Donnell location was the driving of a 1500-foot tunnel through one canyon wall to carry the stream around the dam site while the construction was under way. This bore was advanced entirely from the downstream end as the upstream end was to be below the level of the streambed. When the heading was nearing the upstream portal and water appeared in an 11-foot drill hole, work proceeded cautiously. The final 10 feet was removed with a heavy shot. After the tunnel has served its purpose, a gate structure will be erected at the upstream portal and the flow shut off. The tunnel will then be permanently sealed with a 40-foot-thick concrete plug.

With the stream shifted out of the way, the work of removing some 245,000 cubic yards of loose material from a wedge-shaped opening for the dam footing was begun in October 1955. This excavation was 90 feet long and 120 feet wide at the top. A Manitowoc 5-yard crane working alternately as a dragline and a clamshell lifted material out and into trucks as long as this was possible. Later a bulldozer was lowered into the hole to fill skips for the crane to handle and the final material was loaded by hand shoveling. The upstream face of the excavation was held to a slope of $\frac{1}{2}$ to 1 by placing timber bulkheads arranged in steps or offsets. The timbers were held in place by wire ropes strung between the canyon walls, to which they were anchored in drilled holes. The excavation was carried to a depth of 197 feet before bedrock was reached. The bottom was then grouted to fill any cracks in the rock and thoroughly cleaned prior to the pouring of concrete.



Another job that was tackled without delay was the driving of the 37,696-foot power tunnel, of horseshoe cross section approximately 12x12 feet. This was excavated from three points: the downstream or outlet end and two intermediate points to which access was gained by driving adits into the canyon wall. The first of these openings is only 200 feet long and meets the tunnel at a point 1606 feet downstream from the intake at Donnell Dam and is known as Heading No. 1. Heading No. 2, reached through an 800-foot adit, is 27,000 feet downstream from No. 1 and 9090 feet upstream from the outlet end, which was designated as Heading No. 3.

Heading No. 3 was opened first and



adits required to reach the two other headings were meanwhile being driven. After Adit 1 reached the tunnel line, a heading was turned toward the intake end and the intervening 1606 feet was excavated. At the same time, driving was begun in the opposite direction toward Heading No. 2. In the meantime, driving from Heading No. 2 toward Heading No. 1 had been started. Thus, after the stretch from Adit 1 to the inlet end was completed, work was under way at three headings. The final "holing through" between Adits 1 and 2 took place on last December 11. Progress averaged 45 feet per day at each heading. The crews worked three shifts, 6 days a week.

The entire tunnel was driven with three truck mounted 2-platform carriages or "jumbos," each carrying either 5 or 6 Ingersoll Rand DB-35 power-feed drifter drills on 48-inch aluminum shells and equipped with centralizers to hold bits steady against the rock face while starting holes. Each drill was mounted on an I-R hydraulic boom that provided easy handling and a high degree of maneuverability. Hollow round drill rods of 5- and 9-foot lengths were used,



PHOTOS FROM MORRISON-KNUDSEN, INC.

TIGHT FIT

The roots of Donnell's Dam were planted on bedrock 197 feet below the streambed in an excavation that narrowed down to a few feet wide at the bottom. Because there wasn't room for mechanical equipment, the final 35 feet of material was removed by hand shoveling it into skips. Timber bulkheads arranged in tiers or setbacks (above) were constructed to hold the upstream face intact. Pouring of some of the first concrete in the cleft is shown at the right.



with 1 5/8-inch Carset (tungsten-carbide-insert) bits. The average round of 55 to 60 holes produced an advance of around 8 feet. The rock was sound granite throughout and stood well. The entire length of invert is being paved with concrete but the remainder of the section was lined only where this was necessary

for support. An I-R sump pump accompanied each carriage to dispose of casual water at the headings.

Compressed air for tunnel driving was furnished by Ingersoll-Rand machines. Heading No. 1 was supplied from the main compressor plant at the dam containing two Class PRE 2-stage, 21-inch-

stroke, 2700-cfm units, each driven by a synchronous motor. Duplicate installations at headings 2 and 3 consisted of two 125-hp Motorcompressors, with Class VM-2 aftercoolers for removing excess moisture from the air.

Rail-truck mounted, 3-deck drilling jumbos carrying 8 DB-35 drifters on



WORK ON DONNELLS ABUTMENT

Drillers using J-50 Jackhammers (left) were suspended on safety lines on the steep right abutment. The abutment is shown (right) about ready to receive concrete. An air line is visible at the left. As a concession to the steep terrain,

approximately 110,000 linear feet of light, easily handled aluminum pipe in three sizes is used for conveying compressed air and water. It costs more than steel pipe, but requires far less labor for moving and extending lines.

Hydra-Booms were employed to excavate the diversion tunnels at both Donnells and Beardsley dams. Those bores (approximately 19 feet in diameter) were larger than the power tunnel and only a few hundred feet long. To cover the larger heading areas, the jumbos carried eight drills instead of five or six. All told, 25 of the DB-35 drifters were available. Drill rods and bits used in the tunnels and the other rock excavation work at the two dams were reconditioned at a central blacksmith shop with Ingersoll-Rand equipment, including a drill-steel furnace, a No. 54 drill-steel sharpener, two Jackbit grinders, a shank grinder and an abrasive wheel cutoff machine. Rods were threaded on a Toledo unit.

Construction at Donnells Dam was under the general supervision of Bernard (Woody) Williams, Morrison-Knudsen vice-president, until his untimely death last August 4. Mr. Williams had been prominent in the construction world ever since he had charge of tunneling at Hoover Dam. He was succeeded at Donnells by G.M. Shupe, Morrison-Knudsen administrative manager, dam division, Boise, Idaho. E.C. Shipp serves as project administrative manager; Simon Piedmont is dam project manager; D.M. Drugan, office manager; Stanley M. Stearns, project engineer; and J.L.

Wixson, superintendent for the powerhouse area. George Underwood served as general tunnel superintendent until transferred to an M-K job in Boston, Mass. The tunnels were completed by P.M. (Whitey) Lee, who had been Underwood's assistant. John Holmes was tunnel engineer and C.L. Marmon is general master mechanic.

At Beardsley dam site, also, the first order of business was to dry up the streambed by driving a diversion tunnel that will later carry water from the reservoir to the powerhouse. This is 1118 feet long, with 220 feet of open cut at its downstream end. It was lined with a minimum of 1 foot of concrete to give it a finished diameter of 15 feet 5 inches. Concrete was delivered in 4½-yard transit mixers and pumped into steel forms with a Pumpcrete unit. A concrete conduit of the same size was constructed in the open-cut section. Before the stream was diverted, the walls of the powerhouse were built high enough to permit finishing them later in the dry.

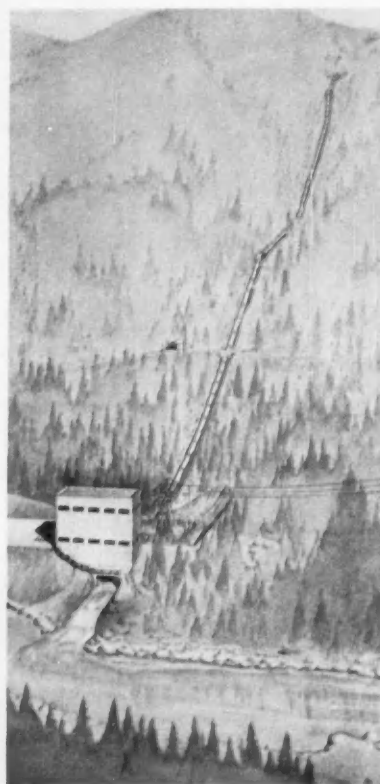
While the tunnel was being driven the stream was directed through a 6-foot pipe laid temporarily down the center of the channel and this permitted excavation for the dam footing to be started. This excavation was carried to a depth averaging 60 feet for a stretch of 1200

feet along the streambed. The exposed bedrock was then grouted and cleaned preparatory to starting the erection of the dam. Power shovels loaded the excavated material into 23 trucks and the same equipment is now being used to handle the material brought in for the dam from borrow pits about a mile upstream in the reservoir basin. As suc-



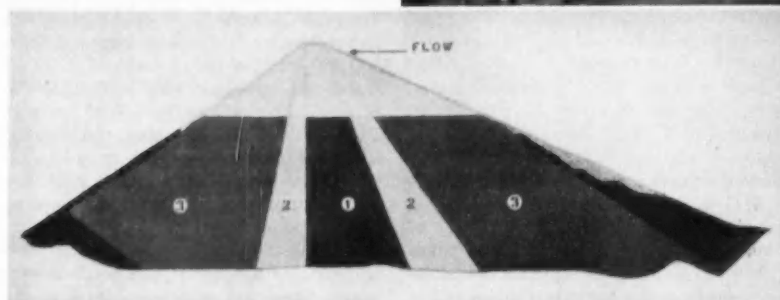
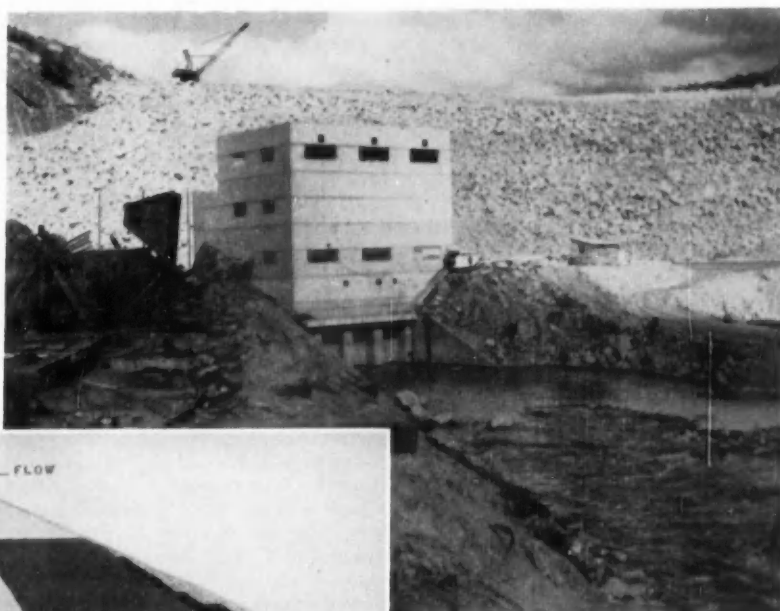
1200-FOOT DROP

The penstock that will deliver water to the Donnells powerhouse (upper right) descends 1200 feet in its 2600-foot length and has to be anchored in concrete blocks at several points to hold it in place. One of these, part way up the slope, is shown (right) with a Gyro-Flo 600-cfm portable compressor that was supplying compressed air for the work there. The picture above shows the powerhouse foundation at the foot of the hill and the stream beyond it. The penstock, 81 inches in diameter, is made of steel and has a maximum wall thickness of 1 3/16 inches.



BEARDSLEY DAM TAKES FORM

The powerhouse and tailrace (right) with the downstream, riprapped face of the dam beyond. About 75 percent of the embankment was in place when this picture was taken. The cross-section drawing below shows the construction pattern. The central core of impervious clay (1) is flanked by semi-pervious transition zones (2). Outside of these are zones of pervious materials (3). Blankets of impervious material cover upstream and downstream bases and the upper portions of both faces are protected from wave action by riprap. The spillway gate structure is shown at the bottom with wagon drills in the foreground. The slope was being cleaned off preparatory to paving it with concrete.



ceeding layers of fill are added to the growing embankment, each is compacted with Ferguson pneumatic-tired rollers. The halfway mark in both height and volume was reached in August 1956.

As the dam grows, crews are busy high above cutting more than 450,000 cubic yards of rock from the right abutment to form the spillway section. When the two structures are finished, they will be on the same level. Drilling in the spillway section has been done mainly with Ingersoll-Rand FM-3 wagon drills and two drills mounted on crawlers, using Carset bits. A concrete-lined chute will lead water from the spillway to the river below. Other heavy work involved cutting keyways for the dam in the canyon walls. The FM-3 drills were also brought

into play there, along with J-50 Jackhammers, of which there are 23 on the job. Other air-powered equipment here includes some slusher and utility hoists. Air is supplied by 900-, 600- and 125-cfm Gyro-Flo portable compressors and a group of motor-driven stationary units.

J. N. Wells, M-K vice-president at the Los Angeles district office, is general supervisor of activities at Beardsley Dam. O. H. Tucker is project manager; James A. Hobson, office manager; and David S. Richards, project engineer. Bert Perkins served as general superintendent until transferred to Wishon Dam as project manager. H. J. Hayes was then made excavation superintendent. Chris Nielson is rock superintendent.

The time and money spent earlier to

build good roads into and through the construction areas is paying off now. Thanks to them and good organization and equipment, Tri-Dam Constructors are hitting a fast pace and expect to have power from Beardsley Dam "on the line" this month, or about 20 months ahead of schedule; and from Donnells by next September. Every day they can beat the deadline imposed in the contract will bring them a bonus of approximately \$5000. Conversely, a daily penalty of around \$6000 was specified for running over the allotted time.

Downstream at Tulloch Dam, where construction started in December 1955, the Arundel-Dixon combine is making good progress and expects to meet or better the specified completion date of March 15, 1958. The work involves excavating 190,000 cubic yards of earth and rock, and placing 230,000 cubic yards of concrete. As was the case at Donnells and Beardsley, one of the first operations was the driving of a river-diversion tunnel 14 feet in diameter and 600 feet long, so that work at the dam site could proceed unhampered. Nine FM-3 wagon drills are doing the bulk of the drilling in the keyways for the dam and in the spillway section. In rock that is softer than that at the two upstream dams, Carset bits of 2-inch size have been averaging 1300-1400 feet of hole before being discarded. Twelve J-50A and three J-50 Jackhammers are employed for miscellaneous drilling work and use 1 3/4-inch Carset bits. Other air-powered equipment includes seven paving breakers and four backfill tampers.

W. N. Evans, vice president of L. E. Dixon Company, is directing the operations. Key personnel include E. E. Snyder, project manager; J. B. Gibson,

project engineer; Rube Miller, excavation and general concreting superintendent; C. F. Hellweck, excavation foreman; Pete Ciucci, drilling and blasting foreman; James Morris, carpenter superintendent; and V. A. Miller, master mechanic.

The raising of Goodwin Dam to increase the capacity of the reservoir behind it is being handled by a subcontractor, John C. Gist Company.

When the Tri-Dam Project was in its infancy, B. W. Goodenough was appointed construction engineer by the two irrigation districts and carried on much of the preliminary negotiating and planning. Later the Tudor Engineering Company was also engaged as a consultant and serves with Goodenough, who is listed as project engineer. The George E. Goodall Company, a specialist on concrete arch dams, and International Engineering Company, Inc., are design engi-

neers. A board of consulting engineers is composed of O. W. Peterson, Julian Hinds, Roger Rhoades and Chester Marliave.

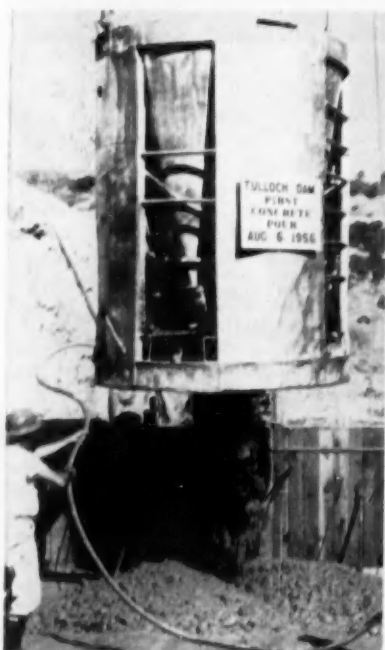
As its part in the Tri-Dam Project, Pacific Gas & Electric Company is spending approximately \$1,000,000. In order to deliver power for use in constructing Donnell and Beardsley dams, it built 11½ miles of 60,000-volt transmission line from its Spring Gap powerhouse and also two substations. From one of the sub-stations, Tri-Dam Constructors built 8½ miles of 33,000-volt line and additional substations to supply the power requirements at Donnell dam site, the tunnel and the construction camp. P G & E built a short tap line into Beardsley dam site. When the Tri-Dam powerhouses go into operation the 60,000-volt line will be converted to 110,000-volt operation to deliver current generated there into the P G & E network. This involves constructing 20 miles of additional line to Curtis substation near Standard City.

P G & E originated in Nevada City, near the famous gold-mining center of Grass Valley and less than 100 miles north of the Tri-Dam construction zone. It stems from the Nevada County Electric Power Company, which built a generating plant 5 miles away on the Yuba River. That firm was later absorbed by

the Bay Counties Power Company, one of a group of utilities that were later joined to form P G & E. The Bay Counties unit is credited with having erected the first long distance transmission line. It carried power from a hydroelectric plant at Colgate to San Francisco. P G & E is now rated as the largest public utility company in existence.

All of the Tri-Dam structures lie in Tuolumne County except half of Tulloch Dam, which is in Calaveras County. They are near the southern end of the Mother Lode mining district that was the scene of one of the world's greatest mining booms following the discovery of gold at Coloma on January 24, 1848 by James W. Marshall. Within 2 years the population of this isolated region rose to 100,000 and in the decade of 1848-58 California produced \$555 million worth of gold. During the Civil War years of 1861-65, this general area contributed the bulk of \$186 million in gold and silver that was shipped to the East and which comprised the principal financing of the Union Army.

Sonora, the county seat, was founded in 1848 and among its first settlers were many Mexicans who soon built a ring where they staged weekly combats between bulls and bears. This practice was stopped as soon as the community elec-



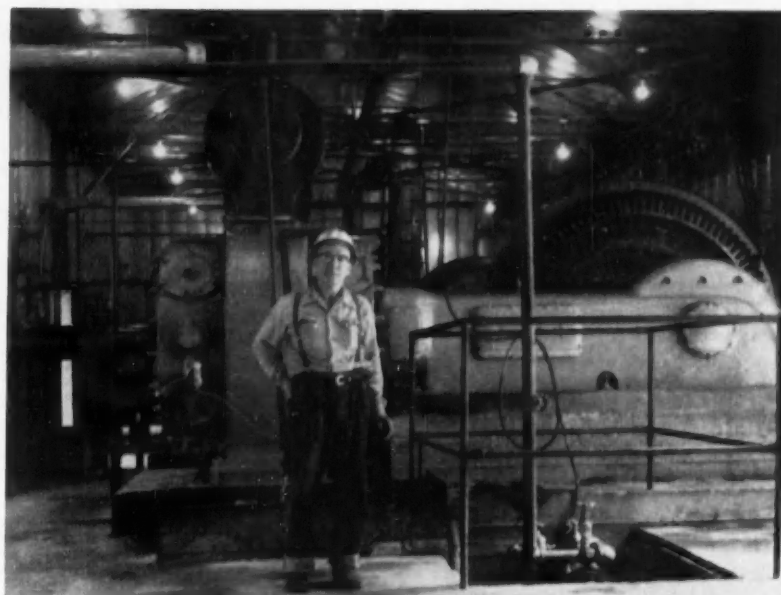
SCENES AT TULLOCH DAM

The right abutment with the rock bared and some of the higher concrete in place (above). Left: Key personnel lined up with the first bucket of concrete poured. The bucket dropped its contents (upper left) when the bottom was sprung open with compressed air conveyed through the hose.

ted a city council in the fall of 1849. All through this area foreigners were made to feel unwelcome and the levying of a monthly tax of \$20 on them beginning in 1850 caused a great deal of strife. Sonora's early construction was of the flimsy sort and a fire on July 18, 1852 virtually wiped the town off the map. Afterward it was rebuilt more substantially and many of the buildings erected then are still standing.

Columbia, which styled itself the "gem of the southern mines," is declared to be the best preserved of any of the early Mother Lode camps and was made a historic state park by the California legislature in 1945. As funds become available, it is planned to restore it to its 1860 appearance. Early-day placer mining required much water and one of the first enterprises at Columbia was to construct reservoirs, canals, etc., to make it available. The first company was boycotted because the miners considered the rates charged too high, whereupon a second concern built additional facilities that included a 60-mile aqueduct winding through the mountains. It reportedly cost more than \$1,000,000, but by the time it was finished in 1858, the easily recovered gold had been extracted and many of the miners were leaving for sections where new strikes had been reported. Meanwhile, a third group began construction to give the town water for domestic and fire-fighting purposes and some portions of the facility are still in service.

Columbia's population in the early 1850's was probably between 10,000 and 15,000 but, beginning about 1860, it gradually dropped and then stabilized at around 500. A telegraph line reached it in 1855 and 3 years later illuminating gas made from pine wood was being distributed through wooden pipes. Destructive fires raged in 1854 and again in 1857 and gutted most frame structures and some brick ones. Structures built later were mostly of brick, with double iron doors and window shutters that were characteristic of early California



AIR POWER IS IMPORTANT

Like all other heavy construction jobs, the Tri-Dam Project uses lots of compressed air. Donnells is the leader in this respect, both because it is the largest operation and also because the driving of its long power tunnel required months of drilling. At the dam are two Ingersoll-Rand stationary compressors (above) that deliver 2700-cfm each, and also portable units of various sizes, including ten I-R Gyro-Flo machines with aggregate capacity of 4480 cfm. At the downstream end of the tunnel are two stationary I-R Motorcompressors and there is a duplicate installation at the Lilly Creek adit. In addition to running rock drills, air power operates paving breakers, hoists, Impacttools, woodborers and other pneumatic tools as well as a drill-steel sharpener, a shank grinder and an abrasive cutoff wheel in the blacksmith shop where drill rods and bits are reconditioned.

mining towns. Some of these are in good condition today.

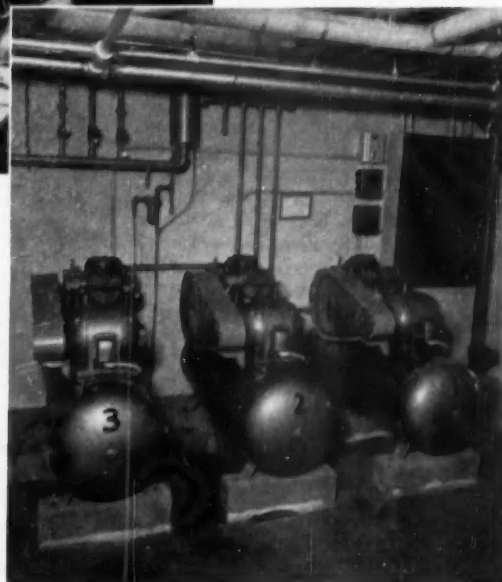
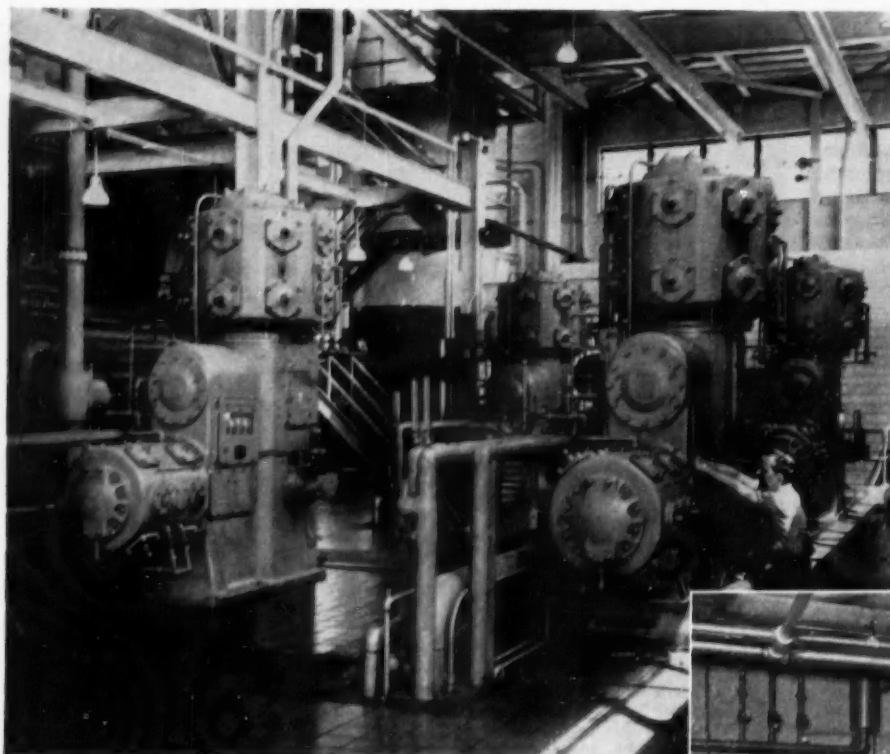
Other points of interest in Tuolumne County include Jacksonville, where miners are said to have paid \$2.50 per plate in 1849 for dinners made up of vegetables from the first garden planted in the county; Chinese Camp, scene in 1852 of a Tong war among 2000 Chinese that left four dead and led to the arrest of 250; a cabin on Jackass Hill where Mark Twain lived for a time in 1864; and Yosemite National Park, of which 435,000 acres are in the county.

Last fall the town of Oakdale, in adjoining Stanislaus County and not far from Tulloch Dam, turned time back with a celebration that featured chuckwagon dinners, street dancing and steer-roping contests. Crews working at Tulloch entered into the spirit of the event and grew beards. The dam is rising near an earlier and much smaller one of the same name that was built to provide power for operating a flour mill. The cement for the concrete in the old structure is said to have been imported from Sweden.



SOME OF THE PERSONNEL AT DONNELLS AND BEARDSLEY

From the left: Simon Piedmont, superintendent; I.L. Wixson, powerhouse-area superintendent; and P.M. Lee, tunnel superintendent, all at the Donnells operation; and Chris Nielson, rock superintendent at Beardsley Dam.



Safety

In the Compressor Plant

The Old Maxim "Safety First" Is Still a Good One

R. J. NEMMERS

SAFETY in compressor plants becomes more and more important as the use of air power grows. Taking certain precautions in the selection, installation and operation of pneumatic equipment can pay big dividends in safety and assure that the user will derive all the benefits of air power. This discussion will be limited to the compressor plant and air distribution system, leaving for future attention the safe use of air tools and other equipment. Most of the material that follows is applicable to both small service-station compressor layouts and large industrial installations.

EQUIPMENT SELECTION

The cardinal rule of safety in any compressor plant is that all equipment should be designed to withstand the

maximum pressure that might be encountered in service. No difficulties need be met in this regard because all reputable manufacturers offer units that provide an ample margin of safety over the normal pressure range for any given application. It may safely be said that the majority of applications for compressed-air power in industry will call for pressures of no more than 150 psi. It should be noted that these requirements are not limited just to the compressor but must include all accessory equipment: piping, valves, fittings, hose, etc. Of particular importance is the selection of an adequately rated receiver. In many localities use of American Society of Mechanical Engineers (ASME) code design and inspection is mandatory; it is desirable in all cases. Be sure, say engineers and in-

surance men, that all legal requirements are met. (Some air-power-equipment manufacturers have a policy of not quoting on receivers with ratings of less than 125 psi. They do this upon the ground that although units would meet code requirements for lower pressures, they might inadvertently, and with disastrous results, later be used for higher pressures.)

COMPRESSOR CONTROL

Merely selecting equipment rated to handle anticipated pressures is not enough: other considerations enter the picture. Of particular importance is the method used in controlling compressor output. "What goes in, must come out," is a law of pneumatics. Putting more air in than is being removed can lead only



SAFE COMPRESSOR INSTALLATIONS

The view at the upper left shows a well-planned, safe compressor layout. The room is well-lighted and spacious; all discharge and cooling-water piping from the compressors is carried out straight and then directed downward into pits in the floor—intake piping is brought from behind the machines also out of under-floor tunnels. All controls are located on a single panel (not shown) and automatic trips safeguard the machines against loss of oil pressure, cooling water, etc. These are Ingersoll-Rand 200-hp Type XLE machines delivering 1000 cfm each and installed in the engine factory of a large automobile manufacturer. The installation shown at the lower left is typical of many automotive shops throughout the country. The machines are in a well-lighted and ventilated cellar location and are accessible for maintenance work. The receiver-mounted units feed the manifold visible on the wall behind and are piped through a separator and automatic trap. Controls are conveniently grouped (right) and belt guards are properly installed on all the machines. They are Ingersoll-Rand Type 30, 5-hp units installed in the repair department of a new-car dealer. The third view illustrates a safe, well-planned hook-up of portable compressors. The I-R rotary Gyro-Flo 600 machines are all equipped with integral safety trips and relief valves. Discharge air is momentarily stored in the tanks on the rear of the machines. Cooled oil is injected directly into the air stream during compression and these machines operate at least 100° cooler than previous reciprocating types. Air is fed to the far-flung work spread through Naylor Spiralweld pipe joined with Victaulic speed-couplings. The pipe is light in weight, yet strong and the couplings enable it to be quickly disconnected at the close of the job. This installation was a contractor's set-up on the New York Thruway.

to trouble by building up extreme pressures in compressor cylinders and piping. Thus another good safety rule is stated: All compressors should be provided with some means of varying the volume of air delivered to the system so that over a given period of time, it equals that which is being taken out. This is done by controlling the pressure in the system in one of the following ways.

Steam-, and to a limited extent, gas-, gasoline- and diesel-engine-driven compressors may be regulated by automatically varying their speed in accordance with demand, thus maintaining an approximately constant discharge pressure. Electric-driven compressors, however, must operate at constant speed and there are numerous methods for regulating them—the choice usually depending on the size of the unit. Small machines, such as those used in automobile filling stations and garages as well as for some industrial applications, most frequently are equipped with automatic start-and-

stop control. This type operates at full speed until the pressure in the system reaches a predetermined point; then an automatic pressure switch opens the motor circuit and the unit stops. When pressure drops to a lower control point, the switch returns to the closed position and the compressor resumes operation. Automatic start-stop machines must have safety guards on all exposed moving parts (as should all compressors). In addition they should clearly be labeled with a warning that the machine is on automatic control and may start at any time. Some users even keep them in a locked wire-screen enclosure.

Where automatic stop-and-start control is not advisable, a so-called constant-speed control can be used. The compressor operates at full speed at all times, the output being reduced in one or more steps to zero thus maintaining discharge pressure within a predetermined range. On small- and intermediate-size units up to, say, 125-150 bhp, constant speed

control often is "all on—all off", that is, the compressor either delivers full output or none. Most of these machines use what is known as free-air unloading in which the inlet valves are held open, thus preventing any air compression.

On larger constant-speed models, step-control systems—most satisfactory of which is automatic-clearance control—often are preferred to the "all on—all off" type. Free air unloading, however, sometimes is used, as well as a combination of free air and clearance control methods. Clearance control operates on the principle that less air will be delivered by a compressor if clearance space in the cylinder is increased. By opening in succession a suitable number of valves connecting clearance pockets to the cylinder, output may be reduced step by step to zero.

Some types of small steam-driven compressors run at only one speed and output must be regulated by one of the constant-speed methods previously described. Larger steam-driven units, as we have said, often are equipped with means for varying their speed to maintain a constant pressure. All, of course, must include a built-in device (governor) limiting the maximum speed. Larger sizes are usually equipped with an automatic safety trip which acts independently to shut off all steam when safe speeds are exceeded.

For pressures usually encountered, either single- or 2-stage machines are used, the choice depending largely on the size of the unit. Two-stage compressors inherently are safer because discharge temperatures are lower. (Air from a single-stage unit may reach or exceed 400°F; 2-stage machines operate 100 to 150 degrees cooler.) Some of the possible hazards which may arise from high discharge temperatures will be discussed later. In general, machines of more than 75 to 100 hp operating at a nominal discharge pressure of 100 psi are of 2-stage construction. In addition to the added safety, their power requirement is approximately 15 percent less.

TYPE OF DRIVE

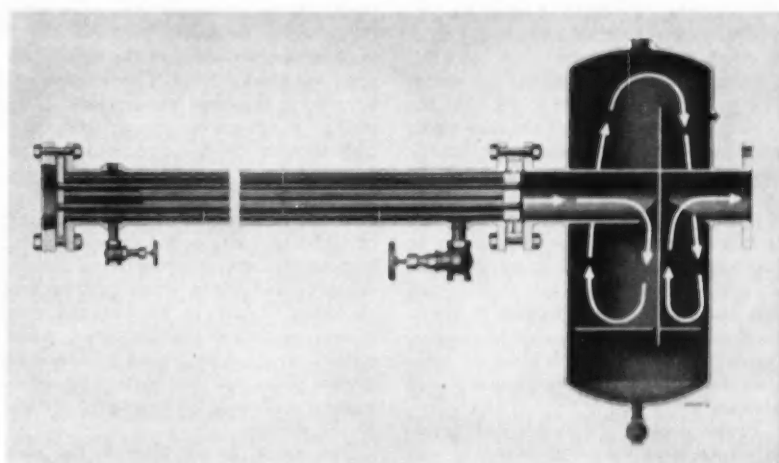
The type of drive selected for a modern compressor plant usually is based on economics. For example, if steam is used in plant processes, it may be the least costly power for the compressor drive. Electric motor-driven compressors up to 100 hp usually are belt driven by induction motors; over 100 hp the advantages of synchronous motors directly mounted on the compressor shaft are so great as regards efficiency, power factor correction, etc., that few machines are driven otherwise. Portable compressors, of course, customarily are gasoline- or diesel-engine driven as are a few stationary units. Needless to say, each driver should be equipped with adequate safeguards. For special applications other

should be given to the use of welded joints wherever possible—they tend to remain pressure-tight longer without care than threaded fittings. For temporary hook-ups there are many varieties of speed-joints available that not only insure a safe system, but one that also can be easily "knocked down" at the end of a job.

Piping should be out of the way and yet accessible. Intake air should be obtained from outside if at all possible, since colder air at the compressor intake lessens the likelihood of excessive discharge temperatures and increases the useful capacity of the unit. The air filter should be placed where it can be thoroughly and conveniently serviced. Discharge piping will always be hot, therefore it should be carried overhead, out of the way, or laid in pits beneath the floor. Also it should lead as directly as possible to the aftercooler; this will improve the over-all operating efficiency of the installation.

No valves should be placed in the line between the compressor and the receiver. It has been said that a good sermon on compressor plant safety would consist of that statement repeated 500 times. If space is so limited that two or more machines must discharge into the same receiver, thus requiring a valve in the discharge line, a safety valve or valves of a capacity at least as great as the full rated capacity of the compressor must be placed in the line between the compressor and the valve. It should be emphasized, however, that for maximum safety no valve should be put in the discharge line; that other arrangements be made if at all possible.

Both the aftercooler and the receiver should be arranged to drain effectively; there should be no opportunity for condensate to freeze up in cold weather—all moisture should be removed from the system as fast as it condenses. Placing the receiver out-of-doors promotes maximum cooling of the air by radiation to the atmosphere. It conserves valuable



AFTERCOOLER AND SEPARATOR

Cut-away view of an I-R PL (Pipeline) aftercooler and separator. Air flow is from left to right through the tubes: cooling water flow is from bottom right to top left around the tubes. The valve at the bottom left is for draining the cooler. The compressed-air industry has standardized on cooling air to within 15°F of the incoming water temperature. In the separator, the velocity of the air is suddenly reduced and this, along with reversals of air flow, effectively traps out condensed moisture.

floor space and makes it possible to have a receiver for each compressor. Trapping out of condensate in the receiver, however, can be a problem in winter. All cooling-water piping, too, should be laid out so that it, as well as the compressor cylinders and the aftercoolers, can readily be drained when the machine is shut down. Good drainage is particularly important if there is possibility of freezing temperatures in the compressor room. It is easy for a cylinder to be cracked by freezing and thus require replacement.

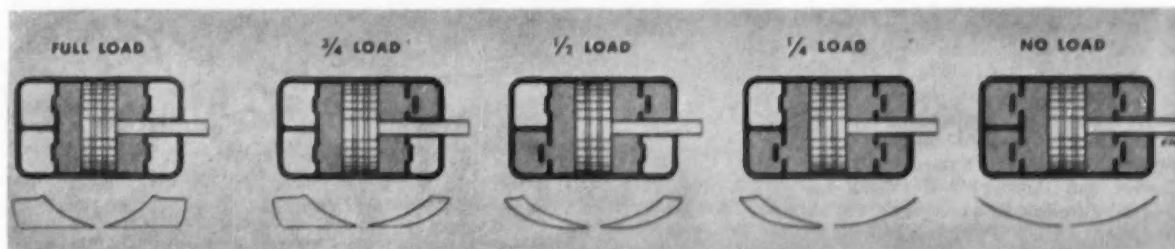
A well planned system for distributing compressed air to the various points of use also will provide for condensate drainage—lines should slope away from the compressor at a rate of about 1 inch in 10 feet. There should be no low pockets that cannot regularly and frequently be drained. In too many shops condensate is removed from lines by

opening a valve and letting the air blow for a considerable time before putting it to use. This is a wasteful and unsafe practice and can be prevented by laying out the distribution system with care. The installation of automatic moisture traps is recommended.

As a part of the installation work, equipment should be painted and cleaned. Every safety man knows the advantages of clean and attractive surroundings and well kept machinery.

OPERATION

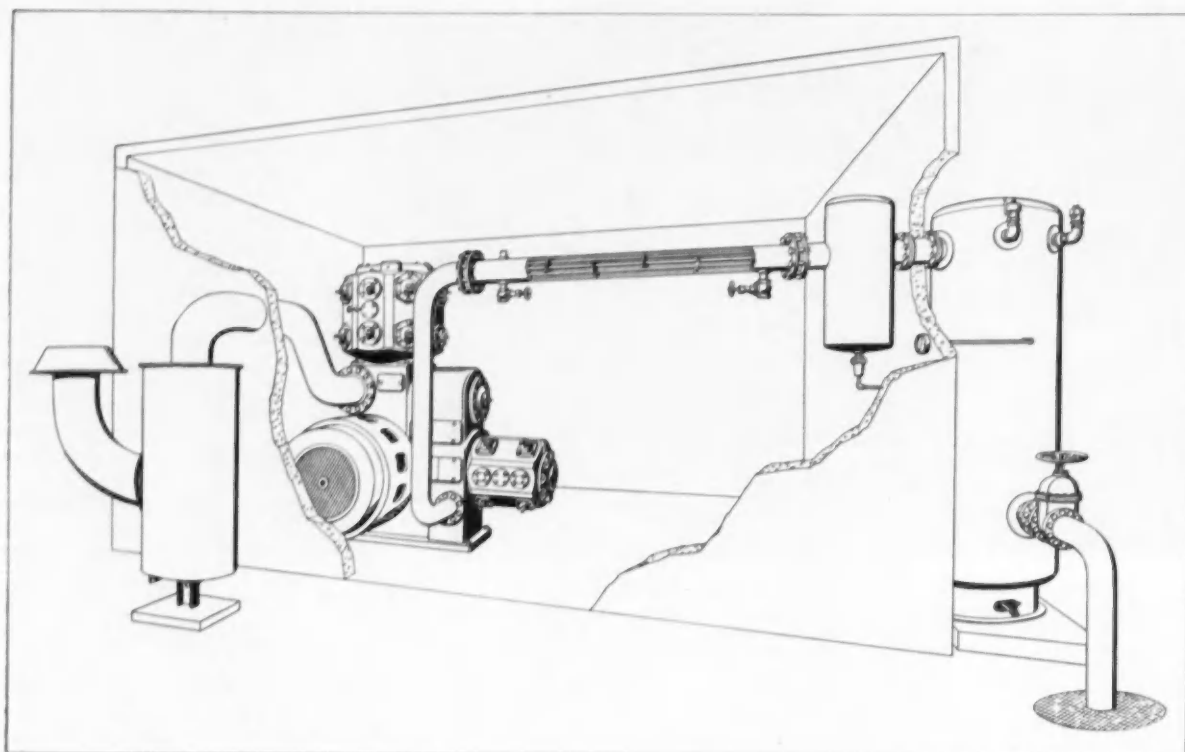
It is a simple matter to test most regulators manually and doing so should be made a routine part of the operators' procedure. Most air compressors unload frequently enough to keep the regulators in working condition. In some cases machines are used for base loads, however, and operate for long periods of time at



CLEARANCE CONTROL EXPLAINED

The sketches and accompanying indicator cards explain the clearance-control system often used on large, constant-speed compressors. Four clearance pockets, each having a volume equal to one-half that displaced by the piston on a single stroke are cast into the cylinder. At full load the valves to the clearance pockets are all closed. At three-quarter load, one of the pockets is opened to the cylinder

and one-fourth of the air usually compressed by a complete cycle of the double-acting piston is merely pumped in and out of the clearance pocket, thus reducing the amount of air delivered by the machine. At half load, two pockets are open; at quarter load, three; and at no load, all four. The indicator diagrams below each sketch show the horsepower requirements of the compressor.



A RECOMMENDED COMPRESSOR PLANT LAYOUT

The compressor plant sketched here has all of the elements of a safe, efficient layout. An intake filter, low enough for easy access for cleaning, protects the compressor. A PL (pipeline) aftercooler is installed in the discharge line, which is short, direct-to-the-receiver and overhead out of the way. The separator on the aftercooler is equipped with an automatic trap for condensate blow down and drains inside the building so that there is no danger of the line

freezing in winter. There are no valves between the compressor and the receiver. The latter is outdoors to promote additional cooling of the air and is equipped with adequate relief valves. The outlet from the receiver is carried underground out of harm's way. An air-pressure gauge, piped from the receiver, is mounted inside the building in view of the operator. Cooling-water piping is not shown, but should be arranged so that it is self-draining.

types of automatic shutdown trips or safety devices may be specified by the manufacturer and his recommendations should always be carefully considered.

ACCESSORY EQUIPMENT

Each compressor must be equipped with a good intake air filter. Any reputable filter manufacturer or the compressor builder can recommend an adequate unit for any given machine. Keeping intake air clean will result in safer operation: build-up of foreign matter on valves and in cylinders is thus prevented along with attendant wear and inefficient operation. Studies have proved that use of good air filters will markedly reduce compressor maintenance costs. An air filter, depending on how dirty atmospheric air is at the compressor plant, often can pay for itself in only 6 months to a year.

The wise purchaser will also install an aftercooler to cool the air as it comes from the compressor and before it passes into the receiver and system. This unit removes excess oil carried through the machine and will condense and remove water vapor, which is always present to

some extent. It also eliminates weakening of pipe lines or opening of joints by alternate expansion and contraction resulting from heating and cooling. One question frequently asked is, "How far should air be cooled in an aftercooler to accomplish desired results?" The answer, of course, is a compromise between cost and results. The compressed air industry has standardized on cooling within 15° of the incoming water temperature. This keeps the coolers economical in size, requires a minimum amount of water and reduces the temperature of the air to a point at which most of the moisture is removed.

In addition to the aftercooler, each compressor should have its own air receiver. This vessel provides a reservoir against peak consumption periods; maintains a more nearly constant pressure in the system; and assists in removal of moisture and oil. Both the receiver and aftercooler should meet the ASME code for unfired pressure vessels if applicable and should be designed for a pressure slightly higher than the expected normal. A stamp of inspection and rating on the receiver simplifies insurance procure-

ment and subsequent inspections. The use of air tanks which have not been regularly inspected and tested is still too prevalent and cannot be too strongly condemned from a safety standpoint.

INSTALLATION

Careful installation of a compressor plant and distribution system is required both for reasons of safety and for obtaining maximum efficiency of operation. First, of course, the compressor must be suitably located. Safety and economy will result if the proposed space is well lighted, if crane service is provided in cases where heavy parts are to be handled during erection and maintenance, and if plenty of room for normal activities is available.

The best rule for systems is to plan ahead: piping of adequate capacity for the volume of air which it will be expected to carry not only now, but in the future, should be selected. When in doubt it is best to choose the next larger size of pipe: its installed cost is not much more than that of a smaller size and it can save many times the small premium by increasing efficiency. Consideration

MORE ABOUT TRACTORS

THE ARTICLE on the Caterpillar Tractor Co., in our December 1956 issue has brought us several letters and additional information on the invention and introduction of crawler-mounted tractors. While it is true that the Holt and Best interests (now Caterpillar) were the only early builders of such equipment to continue in business, it is only fair to note that Alvin O. Lombard, of Waterville, Me., conceived the idea of this type of traction in 1900 and received a patent on May 21, 1901 on a tractor of that type.

The record shows that Lombard's creation was intended for and used primarily in logging service. It appears that the inventor never visualized its potentialities in the fields of agriculture and construction. Lumbering was a leading activity in Maine at the time and something was needed for hauling logs out of the woods when the ground was covered with snow. Horses were being used for the work but were seriously handicapped in wintertime.

Lombard's machine was designed to meet this need and was commonly called a log hauler. He referred to it as a locomotive that would travel on snow. It was steam-driven and resembled a railroad locomotive. It weighed 15 tons, or about twice as much as the track-type tractor brought out by Benjamin Holt a few years later. (There is evidence that Holt's first crawler-mounted model was operated with steam, but the units used for haulage service on the Los Angeles Aqueduct desert construction work in 1907 were powered by gasoline engines.)

According to the book, *Just Maine Folks*, Lombard was born and raised in Penobscot County and exhibited a decided inventive bent when still a boy. He made various mechanical toys and rigged up labor-saving devices for lightening the chores assigned to a brother and himself. His father had a sawmill, so he built a miniature one run by a water wheel and utilizing a saw made from steel taken from an old hoop skirt. He also harnessed the family churn to a larger water wheel.

Alvin began working in his father's mill at the age of 8 and in succeeding years learned all phases of the business. Later he built his own mill, from his own plans. He started thinking about his log hauler while watching horses straining to drag heavy sleds of logs out of the woods in winter. The answer didn't come to him, however, until many years later, after he had retired and was living in Waterville. During a street-car conversation, Edward J. Lawrence, head of a large lumbering firm, told him of the haulage and deplored the fact that many of them had to be destroyed each year

because of injuries that befell them. Once Lombard's mind had been thus returned to the matter it didn't take him long to hit upon the crawler idea. Two days later he walked into Lawrence's office in Fairfield and laid on his desk a wooden model of a tractor that he had whittled with his pocket knife.

After his head mechanic had passed on it favorably, Lawrence asked Lombard to build an experimental model and try it out during the following winter. This first machine was made in the shops of the Waterville Iron Works and operated so well that Lombard erected his own factory and began production.

The first five units turned out in 1901 were sold for \$5000 each but with the provision that the purchasers were not to pay for them until they had been proved satisfactory in every respect. One of the five was bought by Phoenix Manufacturing Company of Eau Claire, Wis., which firm soon afterward contracted with Lombard to build the machines under license and pay \$1000 royalty on each one.

By 1906 Lombard had got most of

the "bugs" out of the log hauler and changes that he made in doing this led to a second patent in 1907. He then began building his "standard machine," which was priced at \$5500. Lombard and Phoenix together built more than 200 units up to 1915, when their manufacture was discontinued.

To complete the record, some earlier efforts at tractor building should be mentioned. In 1858 a \$400 cash prize and a medal were awarded a man named Miller for his "steam car" that was judged "suitable for agriculture." In the same year an inventor named Mann showed a crawler at the Albany County Fair in New York. In 1867 a man named Lake built what he called a "Hell Wagon," but apparently never persisted with it. There was also a young fellow named Parvin, from Philadelphia, who created quite a stir with a steam-driven plow at the Illinois State Fair in 1871 and with demonstrations in California during the next 2 years. He got as far as establishing an office in Chicago and a factory downstate, but eventually closed for lack of capital.



WHEN PNEUMATIC TOOLS CAME TO BARRE

Granite from Barre, Vt., is known far and wide as an excellent and attractive stone for building construction, monuments, plaques and special purposes. Barre quarries, which generate an annual payroll of around \$8 million, use mechanical equipment liberally now but once depended largely on human muscles. Pictured is a demonstration, on April 12, 1903, of the first pneumatic drills used in the district. The scene was Smith's Upper Quarry, now a part of Reynolds & Son, Inc. We publish it through the courtesy of Ira A. Robinson, Jr., of that firm, who states that the tools were made by Ingersoll-Sergeant Company, predecessor of Ingersoll-Rand Company. Second from the left, holding one of the drills, was W.G. Reynolds. The other tool was held by a Mr. Marrow. He and the next man to the right, E.H. Deibaugh, are identified as salesmen. Others shown, all local residents, were D.W. McDonald, George B. Milne, James K. Pirie, J.G. McLeod, Donald Smith and H.J. Edwards.

full capacity. Eventually their regulators may become stuck; the best rule is to check them daily.

Steam driven units should be examined at regular intervals to see that the governor does not permit the safe maximum speed to be exceeded. Automatic safety stops on all equipment should be tripped at least once a week—more often if possible. All safety valves should be sprung by hand at least once a day to make sure that they are in correct operating condition and to clear them of any dirt that might have lodged in them. Each safety valve also should be checked regularly to see that it is properly set—that the “pop-off” pressure has not been altered.

Proper cooling of cylinder jackets and aftercoolers is very important to safe operation. The cooling-water supply should be reliable and as cool as possible. It also should be clean: if it contains scale-forming substances, channels of flow eventually will become restricted, heat transfer efficiency will suffer and overheating will result.

LUBRICATION

Correct lubrication will do more to promote safety in the compressor plant than anything else. Air compressor cylinders require extremely little oil, but it must be of the best grade. A good practice is to buy from a reputable firm and select a type specifically refined and recommended for compressor service. When first starting a new or overhauled compressor, engineers recommend feeding an oversupply of oil to aid breaking-in and to flush out any dirt. Naturally the compressor should be cleaned thoroughly before being put into operation, but nevertheless some dirt will remain. After a few days of running, the oil supply should be cut down until intake and discharge valves (check both) become only slightly greasy—neither dry nor wet. By no means should there be oil accumulations in valve pockets or cylinder discharge passageways.

Compressor valves are subjected to extremely hard service. They open and close rapidly and consequently are made as light as possible consistent with required strength. It is not expected that valves will last indefinitely: they must occasionally be replaced and should be regularly inspected. Depending on service conditions, they should be removed every 3 to 6 months, to be cleaned and thoroughly examined for broken or excessively worn parts. Valves are likely to break if dirt is permitted to accumulate in the system. This dirt may be oil soaked if too much or a poor grade of oil is used and it will soon bake into a carbonaceous mass. When a broken valve, particularly a discharge unit, is allowed to operate for an appreciable length of time, leakage of hot compressed air back into the cylinder during the suc-

tion stroke increases the discharge temperature markedly. Eventually it may become so hot that the dirt-oil deposit will start to burn. Combustion will be rapid in the dense atmosphere. If the residue is extensive, the pipe or vessel may become red-hot and unable to resist pressure, or an explosion could occur. Piping fortunately is not always ruptured, but there is always danger that it could be. An aftercooler, by eliminating high air temperatures and by condensing excess oil and discharging it, will prevent explosion or fire in all but the most grossly neglected installations. Aftercoolers are good insurance for any compressor plant and they materially reduce upkeep of air tools by getting rid of water in the system.

The use of an air filter on the compressor intake not only protects the machine from abrasive dust, but is a good safety measure as well. Clean valves are less likely to break. If they do, and leak for some time before being discovered, there is small chance that a heavy carbon deposit has been formed if dust is absent. Air filters require either cleaning or replacement at intervals dictated by operating conditions. They should be inspected at least every month.

Air receivers require little attention outwardly except to see that they are painted. Regular inspection of inside surfaces must be made, however, to make sure that corrosion is not weakening the tank. Normally the inside of pipe lines and receivers is thinly coated with oil that protects them to a certain extent.

A safe compressor plant is not hard to obtain and most of the precautions result in more efficient operation. The safeguards can be summarized as follows:

Buy all equipment, particularly receivers, to meet expected maximum pressures.

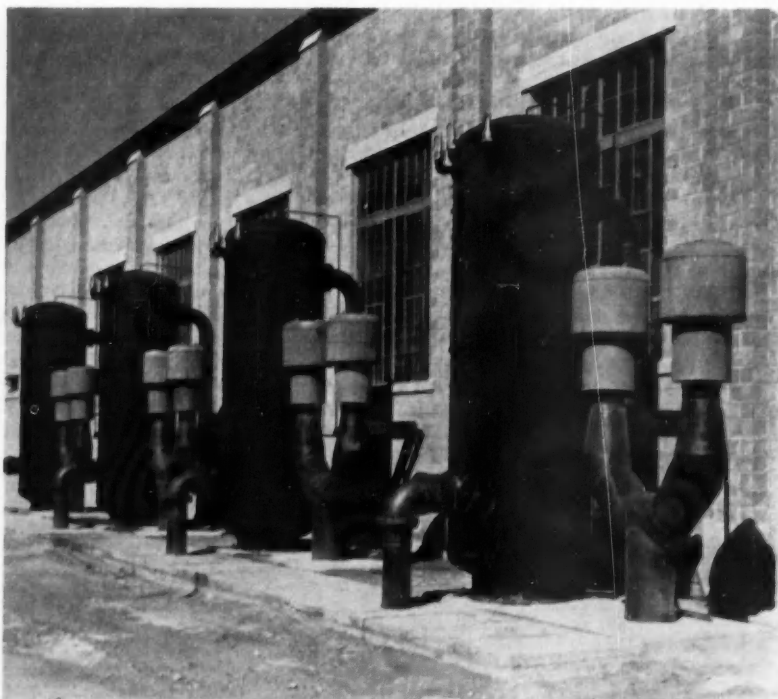
Install the apparatus properly and eliminate valves between compressors and receivers.

See that operators manually check all regulators, governors and safety valves every day.

Inspect and clean compressor valves every 3 months—or more often.

Use the best grade of compressor-cylinder oil and regulate the supply carefully.

Take advantage of the compressor manufacturer's experience and follow his recommendations on design, installation and operation of an air-power system.



RECEIVERS AND FILTERS

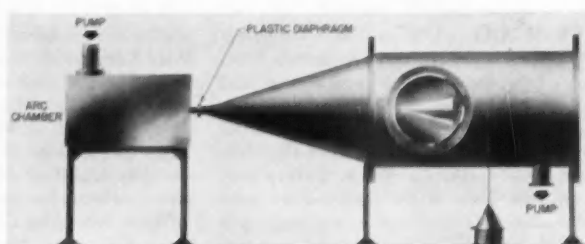
Located outdoors to promote maximum cooling of the air stored in them, four large receivers handle the discharge from the same number of Ingersoll-Rand Class PRE compressors installed at a large mine in New York State. Three relief valves are provided at the top of each vessel. Air distribution lines extending from the receivers are carried underground, out of the way. Beside each receiver is the air intake structure for its compressor, with two filters on each line. They are mounted low enough to be serviced easily and the intake vents are at the bottom, thus excluding entry of rain or snow. Intake lines enter the building area underground and then run to the machines in channels below the floorline.

"Hotshot"—New Wind Tunnel for Research

A new type of wind tunnel—capable of simulating 11,000 mile-per-hour speeds and 15,000°F temperatures—has been placed in operation by the Air Research and Development Command, United States Air Force, at its Arnold Engineering Development Center, Tullahoma, Tenn. Tunnel "Hotshot," as it is called, represents a considerable departure from previous wind-tunnel designs, and although test runs last only about 0.01 second many valuable data about missile and aircraft performances in the so-called "thermal thicket*" will be made available. More than 100 successful test runs have already been made.

The extremely short test period seems to leave little time for observing reactions on models of missiles or aircraft, but in reality it would not be possible to run such tests much longer. The high temperatures involved actually melt portions of the model during the brief run. "Hotshot" is being used to explore possible methods for cooling the surface of missiles or aircraft and for investigating materials to withstand high temperature-pressure applications.

*Most scientists use "thicket" in this sense rather than "barrier" as in "the sonic barrier." "Thicket" more aptly describes the phenomenon because "the problems get thicker" as the plane goes faster, whereas once the sonic barrier is passed, no more trouble results.



HOW IT WORKS

The basic parts of "Hotshot's" anatomy are shown above. Prior to a test the arc chamber, left, is charged with compressed air and the test cell, right, is evacuated to a very high vacuum (above one-millionth of an atmosphere). Air is contained in the arc chamber by the thin plastic diaphragm shown at the throat of the conical expansion section of the tunnel. After the preparatory steps, a high-energy electric charge—about 1 million amperes—is released in the arc chamber. This raises the temperature of the air to about 15,000°F and the pressure to about 20,000 psi. The plastic diaphragm is ruptured by the high pressure and the superheated air rushes through the test cell with a velocity of about 11,000 mph, flowing past the model on its way.



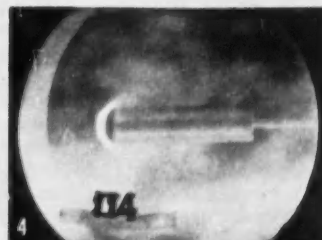
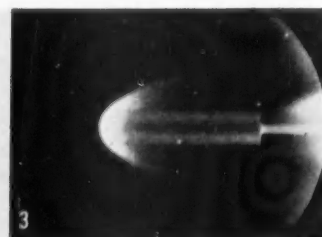
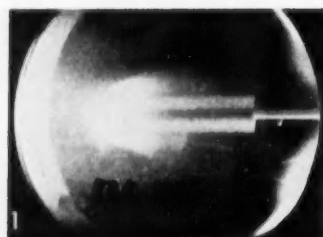
(OFFICIAL U. S. AIR FORCE PHOTOGRAPHS)

"HOTSHOT" AND MODEL

An idea of the relatively small size of "Hotshot" can be gained from this illustration. The test chamber is but 16 inches in diameter. Nevertheless, many previously unobtainable data have been gained from the new type tunnel. A model in position in the test chamber is visible through the observation port (right). At the left is shown a portion of the arc chamber. All observations of model performance and reactions are obtained by automatic recording instruments and cameras—visual observation of the extremely short test consists of little more than a flash of light. Even so, test runs are substantially longer in "Hotshot" than in other previous tunnels. If the reader has access to a camera with a shutter speed which can be adjusted to 0.01 second, he can get the idea of "Hotshot's" speed by holding the unloaded camera up to a bright light and snapping the shutter as he looks through the back.

SELF-LIGHTED PORTRAITS

The illustrations in this sequence show the air flow around the model during the course of a test. In slower speed wind tunnels, photographs such as this sometimes are taken by introducing smoke into the air stream so that flow patterns may be observed. In "Hotshot's" test cell however, the air passing around the model is itself heated to luminescence and provides enough light to register on film. These photographs were taken with a high speed (7000 frames per second) motion picture camera. In picture sequence a test proceeds as follows: 1. Air flow starts and air begins to glow; 2. Peak air flow (and maximum luminosity) is reached; 3. Air begins to lose speed; 4. End point has been reached, but nose of model is still glowing from the heat. It is interesting to note that an entire test may be photographed by only 70 film exposures of the ultrafast camera.



Editorials

ONE HUNDRED MILLION TONS

ON FEBRUARY 4, Climax Molybdenum Company's mine on Bartlett Mountain, near Leadville, Colo., produced its one-hundred-millionth ton of ore. Ceremonies marking the milestone drew company and state officials to the rarefied atmosphere of the town of Climax and were reported by the press, radio and television. The achievement gains stature and significance in view of the fact that, as late as 1912, anyone could have had the huge deposit of low-grade molybdenum sulphide ore almost for the asking. Now it yields half or more of the world's supply of a metal that has come to be classed high on the list of strategic materials.

Molybdenum is an intriguing metal and the town of Climax is unique among American mining camps. The metal's name was applied by the Greeks to what we call lead. Molybdenum looked so much like lead that they confused the two and that uncertainty has come right down to modern times. Most of those who didn't think molybdenum was lead called it graphite, and that error was made with regard to the Bartlett Mountain deposit as recently as 1890.

Any use of molybdenum in steel prior to 50 or 60 years ago was the result of accident or guesswork, because little was known of its properties. Years ago a German steel expert analyzed a part of a sword blade made by a famous Japanese artist in the fourteenth century and discovered molybdenum in it. It was probably present as an impurity in the iron from which the steel was made and as the sword was of particularly fine quality, the German went to some pains to find out where the iron ore came from. Subsequently, the Germans began buying ore from the source in rather large lots, much to the mystification of the Japanese. Later, when steel from captured German World War I cannon was analyzed, molybdenum was found in it.

When pure, molybdenum is a silver-white metal that resembles tungsten but is only about half as heavy. It is malleable and softer than steel. Almost 90 percent of the U.S. consumption is used in alloying steel. Even one part molybdenum to 400 of steel is beneficial to the grain structure of the alloy and improves its machinability. In larger amounts, "moly" is a constituent of high-speed tool steel. It, like tungsten, renders tools capable of cutting at red heat, so it is apparent why molybdenum is important in speeding the manufacturing of armament.

The fabulous Climax Mine is top ranked in several respects. Extracting and milling around 30,000 tons a day, it is probably America's largest underground mine. Perched in the clouds at

close to 12,000 feet altitude it is the highest metal producer of any consequence in this country. The town of Climax, just downslope from the mine, is reputed to be the nation's loftiest post office. It was named by the Colorado & Southern Railway to signalize the culmination of the task of building a single-track line to this saddle in the range called Fremont Pass. Living there has its frustrations, among them the fact that it takes 7 minutes to boil a 3-minute egg and proportionately additional time to boil potatoes or any other foodstuff. Some snow commonly falls on the town during every month of the year and when the temperature hits 72° in the summertime, the natives speak of a heat wave.

Bartlett Mountain was well pock-marked with prospectors' pits prior to the turn of the century. Those who dug there were seeking gold or silver and usually went away disgusted with the blue-gray stuff that gave negative reactions when tested for precious metals. Later, when the identity of the deposit had been determined, nobody knew what to do with it. Not until word leaked through that the Germans were using it in World War I munitions, was interest aroused. The original development work on Bartlett Mountain was done by American Metal Company in 1916 and a year later it formed Climax Molybdenum Company as a subsidiary. Since then there have been corporate changes.

There was considerable production in 1918, when the metal went into steel to further our war effort. As soon as the conflict ended, however, the demand for molybdenum ceased and the title of "War Baby" was appended to the enterprise. The mine was obliged to close, but not for long, and the fiscal fortunes of the company since then have become almost a legend in Wall Street.

Although the Climax company closed its mine, it didn't vegetate but, instead, launched a metallurgical research program that gradually developed peacetime applications for molybdenum and enabled it to reach the enviable position it occupies today. Its first real encouragement came when Studebaker and General Motors started using molybdenum steel in some of the moving parts of their automobiles. Subsequently the alloy was adopted for tubular members in airplanes. Among recent developments is the use of molybdenum disulphide as a lubricant.

The mine was reopened in 1924 and has since been operated continuously, although at varying rates of production. Facilities for both mining and milling were greatly expanded during World War II and the Korean outbreak. In 1953, which is the latest year for

which official Bureau of Mines statistics are available, the United States accounted for about 92 percent of the world's known production of molybdenum, our share being 57 million pounds. Only two mines operated exclusively as molybdenum producers and of these, Climax was by far the largest and probably was responsible for a goodly proportion of the 65 percent they contributed. Most of the rest of the nation's output was in the form of by-product ore, mainly from copper mines.

A BOW TO SUPPLIERS

A UTAH metal-mining concern, New Park Mining Company, describes itself in a paid advertisement as "an organization operated on principles of fair treatment for employees, stockholders and suppliers." This idea of recognizing the supplier as a member of the team, so to speak, is relatively new in industry but is gaining in acceptance. Industrial leaders have long realized the vital part played by the purveyors of everything they need to function properly, from pins to power presses. Now, however, is the tendency to give public utterance to their feelings.

Harry W. Morrison, dynamic head of the world-girdling contracting firm, Morrison-Knudsen, Inc., of Boise, Idaho, paid tribute to suppliers some months ago on the page that is reserved for his thoughts in the company's monthly publication, the *Em-Kayan*.

"We construction people," he wrote, "sometimes speak in uncultured slang of the 'peddlers' from whom we buy the machinery, tools and supplies that are indispensable to the conduct of our business. Yet, in a big company like ours, not a day passes that we could do without them."

"Modern heavy-engineering construction is a business of machines—larger and better, more-powerful machines that do more work faster and cheaper—and specialized machines with new inventions, performing feats that were impossible a year ago. The manufacturers and their representatives in the field are invaluable associates of the contractors, to whom they often render special service beyond the requirements of selfish interest."

"Our 'peddler' friends—many of whom are close personal friends—compose a very substantial section of the country's heavy industry and their ethical standards in a highly competitive field are generally of the highest. When their normal production was paralyzed by war restrictions, many equipment companies and men performed wonders in scouring the country to supply machines or parts to many a contractor, including M-K, hard-pressed to equip a vital job."

This and That

Diamond Technology Classes

Thousands of dollars worth of diamonds are being sawed and filed at Illinois Institute of Technology in Chicago, Ill., in the nation's first course in the preparation and use of the stones as industrial tools. The non-credit evening classes were begun at IIT in September 1956 as a part of the educational program on shaped-diamond technology established there by Industrial Distributors, Ltd., of Johannesburg, South Africa. Selection of diamonds for various uses, sawing and shaping them for tools, and turning, boring and wheel dressing are covered in the course, according to Dr. Frank D. Carvin, director of the mechanical engineering department. About \$40,000 worth of diamond-working equipment—most of foreign make—is used in the laboratory sessions. Classes meet twice a week for 15 weeks and prerequisites for registration include both a high school diploma, or its equivalent, and employment in the machine tool industry. Although the second semester has begun, there are still openings for an intensive 2-week summer course that begins in June.

* * *

Doing It the Easy Way

To eliminate pollution of the River Tidan, in Western Sweden, with waste lye from a paper pulp mill, it was decided to convey the liquid 4 miles out into Lake Vänern through 4-inch plastic tubing. A novel method was adopted for putting the tubing in place. As 1500-foot lengths of it came off machines in a factory located on the shore of Lake Vänern, each was run out a window and into the water. With the ends closed with wooden plugs, the tubes floated. When the number required was on hand, they were towed to the pulp mill, joined and sunk by admitting water and also affixing weights at certain intervals. The shoreward end was connected to the mill's waste outlet. As the lye is heavier than water, it is believed that it will remain at the bottom of the lake.

* * *

Blast Furnace Big Care

Some idea of what is involved in reconditioning a blast furnace can be gained from a report on one of the units at the Geneva (Utah) Works of U. S. Steel Corporation. After 5 years of continuous operation, the furnace was cooled down for overhaul, which turned out to be a 46-day job. Four hundred men, representing all the building crafts, worked two shifts a day,

first removing tons of cinders, limestone, iron ore, slag and worn-out lining and then relining the steel shell. More than a dozen kinds of refractory brick and five kinds of mortar were employed. All told, 650,000 bricks were consumed—enough to build one hundred 3-bedroom homes. Most of the rehabilitation was done by outside contractors, but the operations were charted for them by 1200 yards of blueprints prepared by the Geneva Works' engineering department. The furnace, designated as Number 1, is 100 feet high, has a hearth diameter of 25 feet and a rated daily production of 1120 tons of iron. To support combustion of its coke melting-fuel, it is fed a veritable hurricane of 95,000 cfm of air at 35-psi pressure from an Ingersoll-Rand turboblower.

* * *

Chemical Hats for Reservoirs

The Southwest Research Institute, San Antonio, Tex., has allotted \$25,000 to an 18-month survey of a recent Australian development that is said to reduce evaporation from water reservoirs by about 20 to 50 percent. A large-molecule alcohol—hexadecanol—that has a low evaporation rate and that floats on water but does not mix with it, is used. The Commonwealth Scientific and Industrial Research Organization, which developed the technique, estimates that it costs about 3 cents to save 1000 gallons of water by the hexadecanol process. Scientists from parts of Africa, India and other water-short areas also are studying the chemical hat.

* * *

Fluoride Addition Improved

A new device that promises to reduce by 70 percent the current cost of adding fluoride, a tooth decay preventive, to city water supplies, has been developed by F. J. Maier and E. Bellack of the technical staff of the U.S. Public Health Service. It makes it possible to use the natural-occurring mineral fluorspar, the least expensive form of fluoride, at an estimated average cost of 3 cents per person per year as compared with the 10-cent-a-head rate that prevails in most sections of the country. It was not previously practical to use fluoride because it does not dissolve readily. With the new equipment in use, the fluoride content of the mineral becomes available in the presence of alum, a chemical presently used in many cities to clarify water. The alum solution is introduced to the water by a feeder such as is commonly used in water treatment

plants. The new solvent has been field tested for 6 months and its manufacture by a private concern is expected to begin soon.

The Public Health Service reports that fluoridated drinking water is now available to one-fourth of the people using local public water supplies—more than 30 million persons in 1400 cities and towns. Studies indicate that tooth decay is reduced by as much as two-thirds below normal among children who have been drinking fluoridated water since birth.

* * *

Faster Drying Of Fish

An improved method of drying salt fish as well as other types of meat has apparently been found by scientists at the Atlantic Fisheries experimental station in Nova Scotia. Frozen slices are placed on shelves in a vacuum chamber and warmed to 40-60°C. When the chamber is then evacuated, the ice contained in the frozen tissues sublimates (evaporates) slowly without thawing and the vapor is withdrawn, leaving dry meat. About 15 hours was required to dehydrate a half-inch steak by the method formerly used. This is now accomplished in 3 to 4 hours and only 2 percent of the original moisture is left—considerably less than before. The experimenters dehydrated 3-pound beef roasts in 3 or 4 hours. Fish or meats thus treated are brought back to their original moisture content prior to cooking by immersing them in water for a few minutes. As meats thus prepared can be safely stored or transported without refrigeration, the method is expected to be of value to both military and civilian consumers. No commercial production has yet been planned.

* * *

Asphalt Sandwich Seals Lake

A task of making leak-proof a 100-acre reservoir at the Rocky Mountain Arsenal, Denver, Colo., was recently given to the U.S. Army Corps of Engineers. The man-made lake involved is of oval shape and has a general depth of 10 feet. It was formed in a natural depression by placing a dike at one end and serves as a receiving area for liquid waste containing residual matter.

To carry out the job—reportedly the largest of its kind—the Engineers investigated the possibilities of using cement, asphalt, asphalt planks, impervious compacted earth, chemical grouting and an asphaltic membrane. Because of favorable reports from the Bureau of Reclamation, which had used it on irri-

gation ditches, and for economic reasons, the last mentioned material was selected. A contract was awarded to Long Construction Company of Billings, Mont., and included specifications for laying vitrified-clay pipe lines with chemically sealed joints to carry the waste from the arsenal into the reservoir. The asphalt used was the last residue of the distillation of normal asphalt-base petroleum. A catalyst was blown into it and the result was a tough, rubber-like membrane.

Before placing the substance, a wide strip was graded and compacted with a roller to give a smooth surface. Pre-heated asphalt was brought by insulated trucks and transferred to a distribution vehicle. Unlike conventional equipment for laying tar-like liquids, this one was modified so that the distribution-spray bar was at the side instead of the back.

The asphalt was then sprayed over a 100-foot-long, 12-foot-wide strip at a rate of about 1½ gallons per square yard. To prevent running or sagging, three successive applications rather than one were made before the total specified thickness was attained. The angle of the bar was changed each time and results showed a remarkably uniform membrane that was free from holidays.

Next, elevating graders, working in tandem, spread a 1-foot-wide, 1-foot-thick layer of earth over the asphalt until only 1 foot of the membrane around the edges remained exposed. While this operation was being done, the graders were simultaneously preparing the next 12-foot strip. Before the next section was sprayed, a portable compressor moved along the exposed edge, blowing away dust and dirt that had spilled over it. Thus a clean surface assured a tight bond between the strips of membrane. Overlap varied from 4 to 6 inches.

★ ★ ★

Engineers To Honor Eli Whitney

The American Society of Tool Engineers will honor Eli Whitney by naming for him, a series of memorial lectures, one of which will be delivered annually by the individual selected as "outstanding in having applied the science of tool engineering to the needs of industry." Whitney, best known as the inventor of the cotton gin, is also generally considered to have fathered the idea of using standardized interchangeable parts in manufacturing on a mass-production basis.

Whitney put his idea into effect while carrying out a contract to make 10,000 muskets for the Government in 1798. He agreed to do it in what was considered an impossibly short time by the conventional handicraft methods of that day. He was slow in tooling up for the task and doubts were expressed in Washing-

ton that he would be able to produce the guns. To silence the criticism, Whitney placed ten of each of the parts entering into a musket in separate piles before a group of military and gun experts. He asked them to pick at random one part from each pile and when they had done so, he quickly assembled them into a complete musket and repeated the action until all ten weapons were made up. The demonstration brought him the additional time he needed to complete his preparations.

Louis F. Polk, vice president of the Bendix Aviation Corporation, will deliver the initial address, titled "Heritage and Growing Abundance," at ASTE's silver anniversary meeting in Houston, Tex., this month.

★ ★ ★

Power From Sea Water

It is reported from South Africa that the first power plant to operate on heat derived from sea water will soon be built in Abidjan.

The principle involves taking advantage of the difference in temperature of two neighboring masses of water, a warm one from tropical seas and a cold one from the polar regions. French engineers suggested such a scheme 30 years ago and in 1939 succeeded in operating a turbine for several days solely from the thermal power of ocean water. Further investigation led to formulating plans for a plant in Abidjan, where the natural conditions are favorable. The plant is being designed to produce 7000 kilowatts of electricity and also to furnish, as a by-product, considerable quantities of fresh water derived by condensing the steam from sea water.



May Get Sulphur From Gas

A pilot plant to be operated jointly by The International Nickel Company and Texas Gulf Sulphur Company will be built at Copper Cliff, Ont., to investigate processes for recovering elemental sulphur from sulphur dioxide gas that is produced in connection with Inco's new facilities for extracting iron from the iron sulphides contained in the Sudbury nickel ores. Canada now annually imports some 370,000 tons of sulphur, most of which is used in the pulp and paper industry. The investigations may take several years. If an economical commercial process is developed, Texas Gulf will construct facilities for producing hundreds of tons of sulphur daily. Aside from the commercial angle, a workable process would decrease liberation of the gas to the atmosphere above Copper Cliff. It is now dispersed from a 634-foot-high stack, termed the loftiest smelter stack in existence.

★ ★ ★

Seek Ice Cap Secrets

In an effort to learn some of the secrets that are buried beneath the mile-thick ice cap that covers Greenland, drillers are at work there taking 4-inch cores. Among the things they hope these will reveal are the temperature of the ice at various depths, something about the various weather cycles during the past 1000 years or so, what Greenland was like before the ice cap covered it and data on wind currents from years back by examining particles of volcanic dust and ash embedded in the ice. They also hope to make some sort of an estimate of the ice cap's present and future effect on world weather conditions. The operation is a part of the program planned for the International Geophysical Year and is being carried on by the U.S. Army Corps of Engineers.

The drilling is being done by a portable oil-field-type rig at an altitude of 7000 feet above sea level. Compressed air at 100-psi pressure is the power medium. It is cooled to the ambient temperature plus 10 degrees (averaging around -10°F) and moisture is dropped out of it by running it into a large tank to slow the velocity. The air then turns a turbine that powers the drill and after being further cooled by expansion at the exhaust, is directed down the hollow drill rods and through the bit. It then rises in the annular space between the drill rods and the walls of the hole. As it emerges, its temperature is recorded and this is taken as the temperature in the hole. The precooling to approximately atmospheric temperature is necessary in order for the air to assume that of the aperture during its journey to the bottom and back.



Air Bubbles Battle King Winter

EXPERIMENTS with the use of compressed air for keeping waterways free of ice in winter are continuing in the northern latitudes of Europe and there are indications that the method will be widely applied there. In its simplest form, an installation is made merely by laying on the bottom a pipeline perforated at regular intervals with small holes from which air can issue. The air is supplied by a compressor at the landward end of the pipe. The rising bubbles of air induce circulation that brings up from the bottom warmer water that has settled there because of its greater density. If the air is released before ice forms, it will prevent it from forming. Where the waterway has already frozen over, the ice coating will be melted in a comparatively short time.

In Sweden, various types of pipe have been tried out, including a galvanized

variety that is pivoted at every second joint to facilitate sinking and raising it. However, plastic pipe or tubing is favored because it is easy to handle and perforate. To make one pipeline do the work of two or more, one concern lays the line in a zigzag pattern and thus increases the width of the lane covered. It has been granted a patent on the idea as well as on that of filling the line with water when the air is shut off to prevent clogging of the holes. Experience has shown, however, that the holes rarely clog, especially if plastic pipe is employed. In one installation, 1½-inch plastic piping with 0.030-inch holes was attach-

TWO EUROPEAN EXAMPLES

At a shipyard near Stockholm, Sweden (below), an area of water large enough for launchings is kept open by laying a single galvanized pipeline on the bottom. Air is supplied to it from the yard's distribution system. At the Ka-stets sawmill, in central Sweden (left), open water for floating logs is maintained in a similar manner. The picture shows air bubbles churning the water at various points along the line where the pipe lays submerged.



ed to a steel cable in a manner that held it above the bottom slime.

In one instance on a ferry route, a strip of water 32 feet wide and 1000 feet long has been kept open an entire winter with one plastic hose line. At the edges of the lane the ice reached a thickness of 20 inches. No ice formed in the open water even when the temperature went to -4°F.

The air pressure required varies with the depth of water. In the Swedish tests it has ranged from 43 to 57 psi.

Vegetable Parchments Find New Uses

WRAPPERS for lubricated machine parts, crate and carton liners and sealed packages for caulking compounds are but a few of the many industrial packaging applications that have been found for vegetable parchments of the oil-resistant variety.

The process for manufacturing this paper was discovered in England in 1853 by Prof. W. E. Gaine when he accidentally dropped a piece of handmade cotton rag into a pan of sulphuric acid. In 1861, Warren de Larue of London made commercial quantities of the substance and Paterson Parchment Paper Company began production in Bristol, Pa., in 1885. The paper was originally given the name "vegetable" to prevent its confusion with animal skin papers of a similar appearance. Wood pulp is currently being used in lieu of cotton.

The initial pulping, bleaching and machining steps are similar to those for other papers with the exception that no

sizing is added, and they leave the parchment soft and highly absorbent. It is called "water-leaf" and is composed of 100-percent pure cellulose fiber. This mass is then placed in a dilute sulphuric acid bath that attacks the cellulose fibers and causes a gelatin-like surface to form over the sheet that is made from it. Although it is instantly washed off, enough of the film remains to lock the fibers together. Drying is the next step and it is during this process that extra qualities, such as increased grease resistance, are added.

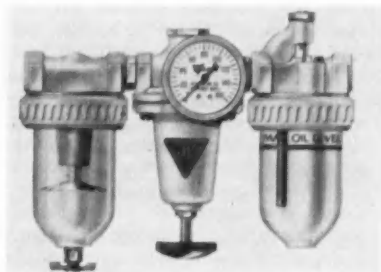
The finished product will not disintegrate when wet, but will absorb up to 100 percent of its own weight in water. When wet, it has good tear strength and heat resistance. When dry, it will withstand temperatures to about 200°F. The parchment naturally prevents oil and grease penetration and when laminated with foil-type papers, produces a moisture-gas barrier.



"While yer down there; look around, there may be termites!"

Industrial Notes

Automatic filtration, regulation and lubrication of air supplied to pneumatically operated equipment are combined in a single instrument developed by Watts Regulator Company. Air passes first through a cyclone separator and then a porous bronze element to be cleaned before entering the regulator area. Once there, instant regulation of pressure under widely varying demands



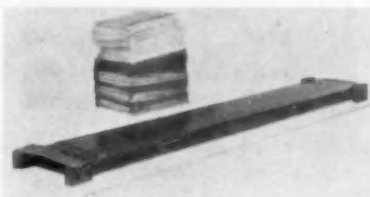
is provided by an aspirator. It is claimed that the lubrication unit of the device assures almost 100-percent vaporization and assimilation of metered oil. The complete filter-regulator-lubricator is available in 1/4-, 3/8- and 1/2-inch pipe sizes for shop air pressures.

Circle 1E on reply card

To eliminate "dry starts" of machinery that has been shut down overnight or longer, Trico Fuse Manufacturing Company has introduced an industrial oiler with special built-in reservoirs that initially, automatically floods bearings with a larger-than-normal amount of oil. Following this flushing cycle, the unit operates in a normal manner, feeding lubricant drop by drop at any required rate. Oil is stored while the machine is idle. Oil flushing is reportedly especially desirable after shut-down periods for vertical shafts, where drain-off is pronounced; for high-speed spindles, where full lubrication is required the instant the equipment is started; for bearings, where high accuracy must be maintained; or where considerable strain, pulling load and weight are present. Kwik-Flush oilers, as they are called, are available in 10-ounce, 1-pint, 1- and 2 1/2-quart capacities, with either Pyrex or Lucite reservoirs and manual or electric solenoid shut-off valves.

Circle 2E on reply card

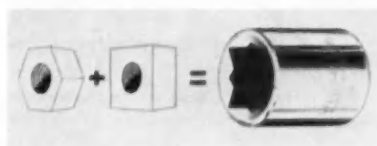
Operating on a principle similar to that used in pneumatic cash-carrier systems in retail stores, The Grover Company's Transutube can be easily installed to increase the speed of moving blue prints, photographs, specifications and similar material from one plant area to another. According to the manufacturer, depending on individual routing-pattern needs, many variations of tubes,



terminals and sub-stations can be designed. A general catalogue has been issued that gives specific data for preliminary planning, for the quantities of compressed air required in various situations, on the types of carriers and systems available and on general uses and users of the equipment.

Circle 3E on reply card

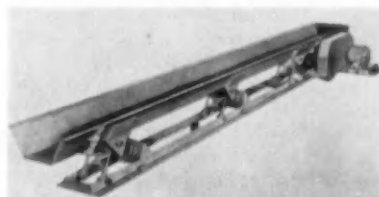
A socket wrench, called Ten Point, fits square and hexagonal nuts interchangeably. It eliminates the necessity



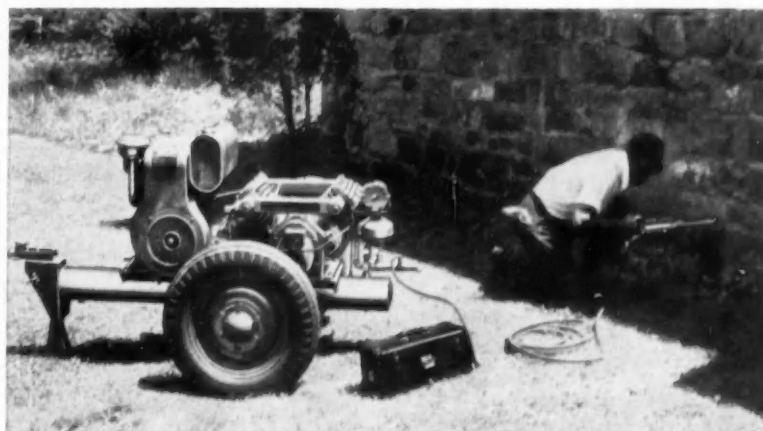
of changing sockets and saves space, weight and purchase costs. The tool, hot-

forged from chrome-alloy steel, meets all government specifications for strength in hexagonal, square or octagonal sockets, according to the Wright Tool & Forge Company, its designer and producer. It will soon be available in 1/4-, 3/8-, 1/2-, 3/4- and 1-inch square drives and can be used with any standard hand-operated ratchet wrench.

Circle 4E on reply card



Coilmount is an oscillating conveyor for handling bulk materials in the intermediate-weight range. It supplements two current models—Flexmount for light duty and Torqmount for heavy jobs. Applications for the equipment include the moving of bottles, cake mixes, abrasive carborundum and sintered ores as well as moisture-free metallic concentrates, streptomycin wastes of 85-percent-moisture content, chips and turn-



He's guilty of "legal entry!"

• This man was caught drilling a hole through a stone house wall for a hose bib with the "right" tools for the job . . . a Wisconsin 4-cycle single cylinder Engine powering an Ingersoll-Rand HG Compressor.

Thanks to the selectivity offered by 14 models in the 3 to 56 hp. range, original equipment builders find there is a Wisconsin engine of just the right size and power for their equipment . . . with this BIG advantage: Wisconsin engines offer an unmatched combination of heavy-duty construction and basic high torque design for most hp. hours and low maintenance!

Our "Spec" Bulletin S-198 gives you complete information with service map and complete list of authorized distributors and service stations.



WISCONSIN MOTOR CORPORATION

World's Largest Builders of Heavy-Duty Air-Cooled Engines Milwaukee 46, Wisconsin

Circle 17A on reply card

ings at room temperature and metals as hot as 500°F. Motion of the trough is imparted by a constant-stroke eccentric drive that produces a gentle upward and forward oscillating movement that causes little damage to the trough and no damage to the materials being moved. Material is carried forward continuously regardless of overloads and surges. Stock sections of from 5 to 10 feet in length and in widths of 10 and 20 inches can be assembled in sections to 100 feet. According to the manufacturer, Link-Belt Company, divider plates are available so that one unit can convey more than one material at a time and auxiliary devices can adapt the model for screening, cooling, heating, drying, elevating, etc. Counter-balanced and spring-mounted equipment is available for applications where vibration should be isolated, as on the upper floors of buildings. Units may be completely enclosed to prevent dissipation of toxic fumes, dust and the like.

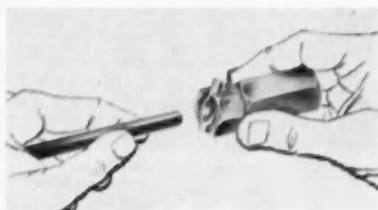
Circle 5E on reply card

A Davis Oxygen Inhalator, it is claimed, can be safely used by volunteer first-aid personnel with a minimum of training. Included in the kit are a plastic facepiece and breathing bag, an oxygen diluter, 4 feet of hose, a pressure regulator, two small cylinders with a ½-hour supply of oxygen and an adapter that



permits either easy recharging of the smaller air-supply units from larger ones or direct use with the latter. The apparatus, produced by Davis Emergency Equipment Company, Inc., is light enough to be used when a patient is being carried on a stretcher or in an ambulance or in applications where equipment must be moved up stairs.

Circle 6E on reply card



For production and maintenance applications involving pressure or vacuum testing, a self-sealing, automatic-locking push-on, pull-off tube plug and connector has been introduced by Mechanical Products Corporation. It provides a

fast, safe and efficient method of attaching pressure and vacuum lines to straight end tubing and permits an instantaneous, leak-proof connection of elements under test to vacuum or pressure sources without the use of tools, threading, soldering or brazing. Reportedly, the device has wide application on heat exchangers, refrigeration units, tube assembly, etc. To attach it, the fixture is merely pushed over the end of the tubing into the stop position, whereupon it locks automatically; pushing a lever permits it to be pulled off. Equally efficient for air, water, steam, oil, Freon 12 and 22, and the like; suitable for temperatures from -40°F to 275°F; and designed to operate at any pressure to 1000 psi and any vacuum to 25 microns, the unit is available in three standard sizes for ¼-, ⅝- and ¾-inch tubing.

Circle 7E on reply card

Sprague Devices, Inc., has introduced a device called Air-Push Spragit to speed the cleaning of small parts. The unit is easily adapted to cover any standard 5- or 10-gallon container. A basket-like element, attached to the upper covering



plate, holds the parts while they are agitated, with air power, within the liquid. As little as 12-psi air pressure is required for operation. Reportedly, this device will cut costs in both time and quantity of solvent required.

Circle 8E on reply card

The Fairbanks Company's Lamilon is a nylon-reinforced all-plastic industrial wheel that provides a new concept in the utilization of one wheel for all materials-handling equipment in any section of a plant. Tests conducted in accordance with American Society for Testing Materials standards, gave the wheels a high rating on impact strength

Aftercooler and Cyclone Separator designed for cleaner, dryer compressed air

R. P. ADAMS CO., INC.

209 East Park Drive, Buffalo 17, New York



The Adams Aftercooler and Cyclone Separator are designed to efficiently condense and remove water from compressed air and process gas. Condensed moisture and entrained dirt and oil are subsequently removed in a cyclone type separator. This unit is scientifically designed for maximum removal efficiency over a wide range of flow rates.

For normal use, units are available to cool gases to within 10° F of the temperature of the cooling water. Specially designed units are available to permit a 2° F approach to cooling water temperature, for application where low moisture content is critical.

Adams Aftercoolers and Separators are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm

where it is necessary to cool within 2° F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases, a pressure drop of ½ psi is assumed at a maximum working pressure of 150 psi.

This wide range of sizes enables the cost-cutting application of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.

Circle 12A on reply card



and abrasion resistance. According to the manufacturer they will retain a smooth tread and perfect concentricity in service, thereby protecting floors against marking or marring; and are especially suited for use wherever different types of floors are encountered. Because the wheel has low-water absorption and oil, grease and chemical resistance, it withstands deterioration. In addition they are spark-proof and have high-load capacities. Units can be furnished in 3- through 12-inch sizes with alloy-steel roller bearings, hardened-steel outer race and provisions for pressure lubrication.

Circle 9E on reply card

Grease, oil, carbon, tar, gums and similar substances can be easily, rapidly and safely removed with a degreaser called Zipp from all types of machinery, electrical equipment, painted surfaces and concrete floors. Packed in 16-ounce aerosol-bomb cans, the fluid contains no carbon tetrachloride. It is sprayed on the area to be cleaned and within a minute the object can be wiped or, if not electrical, rinsed clean with water. Produced by Stewart-Hall Chemical Corporation, the quick-drying spray leaves no film and is reportedly non-corrosive and non-flammable.

Circle 10E on reply card

Clementina, Ltd., is manufacturing a wet hone machine that is claimed to be the most efficient wet-pressure blaster in use today. Irregardless of how long



the equipment has been standing idle, instant agitation of its slurry is possible. By varying pressure and changing the type of abrasive, this unit will clean, de-burr, hone or polish. Good visibility through a wide window, rapid changing of abrasives, easy cleaning and effortless installation are a few of its features. The machine weighs 375 pounds and has an air requirement of 20 to 30 cfm.

Circle 11E on reply card

A diaphragm-type, low-cost gauge protector designed by Superior Hydraulics Division of Superior Pipe Specialties Company is claimed to be a sensitive unit with a rapid response to pressure changes. It automatically cuts out the gauge and by-passes working media whenever line pressures rise above a spring setting in the unit. Especially applicable in air or poisonous-gas service, the device has an external-pressure adjusting control that permits accurate settings from 10 to 100 psi. Units are available with 1/4-inch female pipe or tubing connections and are constructed with corrosion-resistant brass bodies.

Circle 12E on reply card

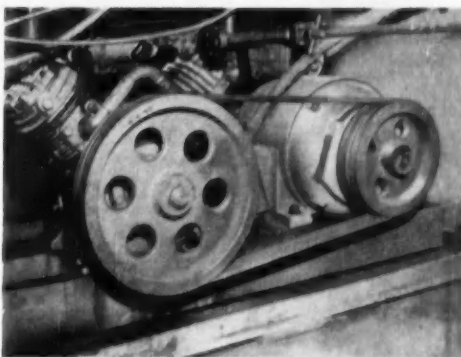
A new pile-driving hammer, the McKiernan-Terry C-5, which operates with either compressed air or steam, features a low total-weight-to-ram-weight ratio and will, consequently, it is claimed, do



the equivalent work of similarly rated conventional hammers with half the motive power. Although the unit delivers 110 blows per minute with a striking energy of 16,000 foot pounds, it is reported to have an extremely low striking velocity. This minimizes pile-head de-

TEAMWORK!

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BROOK A. C. MOTORS provide a smooth flow of power to compressors regardless of climatic conditions. Brook Motors, 1 to 600 HP, cost less initially and assure maximum service life and overall economy. There is no finer motor built. They're powering air and gas compressors from Arabia to Wyoming, stacking up splendid performance records. There's a Brook Sales and Service Headquarters near you. Send for literature.

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Circle 19A on reply card

formation, which is particularly a problem when driving the new thin-wall piles. Yet the hammer, with its high-speed, heavy ram weight and high energy output, can satisfactorily drive heavier piles. The machine will protect itself against damage should the pile slip away because it stops when there is no support under the anvil block. It will go back into operation when support is reestablished. Lubricant is fed through the motive fluid line, thus eliminating the need for stopping the hammer to fill reservoirs.

Maintz, a combination of du Pont's chlorosulfonated polyethylene silicone and other resins, is a coating that provides protection against abrasion, chemical corrosion and weather exposure. Unlike paints, the substance does not form a brittle finish, yet, according to West Chester Chemical Company, its producer, is exceptionally resistant and maintains enough elasticity to withstand expansion and contraction caused by temperature changes. The liquid, available in 1-, 5- and 55-gallon containers in black, grey and a wide variety of pastel colors, is suited for the protection of buildings and equipment in refineries, chemical plants, smelters and marine service. Further information and samples are available.

Circle 13E on reply card

For general duty in factories, foundries, steel mills, railroad and salvage yards, concrete-block and similar plants, Sængen Derrick Company has developed an all-purpose portable crane that is said



to be able to carry a 3000-pound load on a single line with one man at its crank. Because the unit weighs only 350 pounds, it can be tilted back on its two wheels and easily moved through low

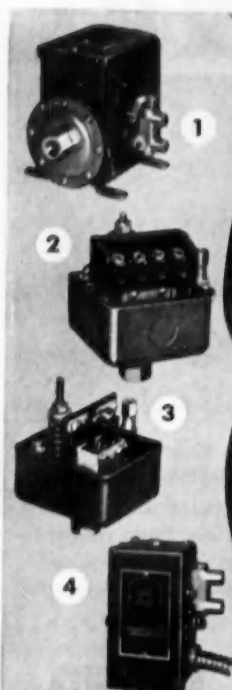
overhead areas. Construction involves a Safety Spur Gear Winch with a 7-to-1 gear reduction to provide rapid, easy hoisting with minimum part wear. Regardless of where the operator stops turning, the load is held safely and securely. This equipment is available in 7½- and 9-foot sizes.

Circle 14E on reply card

For testing pressure gauges to assure their safe operating conditions in oil, steam and gas industries, Amthor Testing Instrument Company offers a dead weight tester. Available in multiple-piston models, low- to high-pressure small-increment testing changes are possible without the use of tools. It is claimed that accurate readings within 0.1 percent are possible.

Circle 15E on reply card

Security Junior is the name of a line of glass-fiber reinforced plastic panels in which is embedded aluminum or steel diamond-shaped mesh. The units, manufactured by Resolite Corporation, offer unusual architectural design possibilities, as well as semi-transparent protection against flying particles and liquid spray. They may also be used as protective skylights and windows. Consisting of either 0.081 gauge expanded aluminum or 16-18 gauge expanded steel embedded in flat Resolite sheets that gives them



SQUARE D

FOR A Complete Line OF H.P. RATED AIR COMPRESSOR SWITCHES

- ① Heavy Duty
- ② Standard Duty
- ③ Gas Engine Cut-Out
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full range of electrical and pressure ratings

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SQUARE D COMPANY

Circle 20A on reply card

GREATER PROTECTION to your AIR LINE! M-B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY
USED FOR
PROTECTION
OF AIR VALVES
CYLINDERS
CONTROLS
PNEUMATIC
TOOLS, ETC.

The **FILTER** removes solids .00039 and larger. Transparent bowl provides visibility. The **REGULATOR** can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The **LUBRICATOR** delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

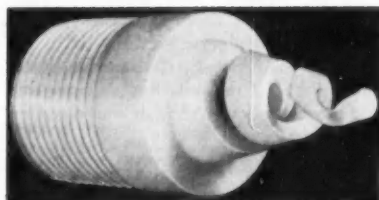
M-B PRODUCTS
46 VICTOR AVE., Div. 14
DETROIT 3, MICHIGAN

Circle 21A on reply card

high impact resistance, they are available in both standard and special fire-retardant varieties and have light transmission values ranging from 71 percent in the clear type to 15 percent in some of the colored varieties. According to the manufacturer, the material has wide applications in both interior and exterior decorative treatments on homes and industrial buildings, as well as in safety situations. They are available in standard lengths of 8 and 10 feet, and widths of 1, 2, 3 or 4 feet; however, special sizes can be supplied.

Circle 16 E on reply card

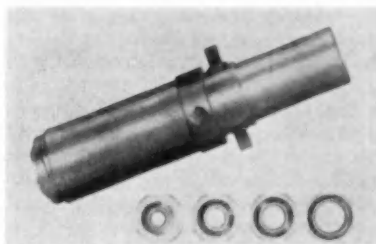
The TF series of fourteen spiral nozzles is made of Teflon by Bete Fog Nozzle, Inc. According to the manufacturer,



full-cone spray patterns, angled from 90 to 120 degrees, in addition to the former line of hollow-cone models are available in a wide range of flow rates. Orifices range in diameter from $\frac{1}{8}$ to $\frac{1}{2}$ inch and flow rates are from 2 to 70 gpm. The spiral design atomizes fluids without the use of vanes or internal parts that tend to become clogged and the Teflon material provides corrosion and erosion resistance. Circle 17 E on reply card

By using a Speed-Thru nipple chuck manufactured by Mercury Hydraulics, Inc., on-the-job threading of pipe or conduit nipples is now possible with either hand threaders or power drives. The manufacturer claims that the device is

the only tool on which nipples of any length can be made with all threaders



adjustable to 2 inches; a movable sleeve guide results in elimination of "dead

spots" that prevent threading to any predetermined length. All wearing parts are made of hardened steel and each unit comes packed in a heavy-gauge metal tool box with holding adapters from $\frac{1}{2}$ - to $1\frac{1}{2}$ -inch diameters. Two-inch diameter nipples thread into the less-than-10-inch chuck body for holding. Adapters for British Standard pipe threads are available.

Circle 18 E on reply card

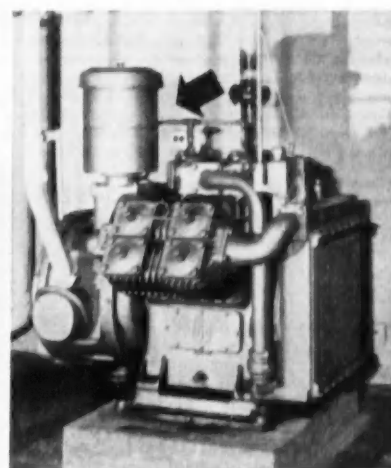
A line of adjustable indicator gauges developed specifically to provide quick, accurate measurement of critical dimensions in shallow slots, grooves and holes has been announced by Ellstrom, Inc.

Whether you build superhighways or inspect train brakes...

*Air-Maze filters will keep your
compressors on the go!*



THESE COMPRESSORS supplied air for wagon drills used on the new New York Thruway at Suffern, New York. Working in dust and dirt, these compressors need clean intake air to prevent serious breakdowns. That's why they're equipped with Air-Maze oil bath filters. These filters scrub intake air clean in a bath of oil, reduce engine overhaul costs, cut maintenance costs and down-time.



AT NEW ORLEANS union passenger terminal, this compressor supplies air for inspecting brakes on trains, operating pneumatic tools, paint spraying and other repair and maintenance jobs. Its Air-Maze oil bath filter keeps air-borne dirt from damaging polished pistons, valves, rings and other vital compressor parts. Specify Air-Maze filters on the compressors you build or buy.



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LIQUID FILTERS • OIL SEPARATORS • GREASE FILTERS

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Circle 22 A on reply card

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"AIR KING" Quick-Acting HOSE COUPLINGS



For All Hose Connections

These plain rugged couplings are your surest safeguard against loss of air at the hose connections. Universal locking heads, on sizes up to 1", snap together to form a secure lock that is leak-proof under pressure; in fact, pressure must be released before coupling can be disconnected. Ideal for rough outdoor work as well as indoor shop and plant service. Malleable iron, cadmium plated, and bronze. Hose Ends, Male and Female I.P.T. Ends. Size range, 1/4" to 1". Also available in 4-lug type, not universal, in 1 1/4" to 2" sizes.



"BOSS" Self-Honing AIR VALVES For the Entire System

The most efficient and economical valves for all valve stations on the system—automatically, permanently leakproof—no packing to wear out and replace—straight-line, full-flow opening through body and plug. Self-adjusting bronze plug automatically hones itself against harder steel or malleable iron valve body, maintaining a perfect leakproof seat. Proper spring tension assures constant sealing adjustment. Strong, durable construction, with handle attached to plug within the valve body. Male or female thread both ends, in sizes 1/4" to 1 1/2".

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Rexon Corp. Company, Inc., Seattle, Pa. - Phoenix Brass Steel Company, London, E.

Circle 23A on reply card

Called Shalo-Chek, the fixture is only 1 3/16 inches high and can be used right at the machine—generally without moving the table or disturbing the set-up—to check depths ranging from 1/32 to 1/2 inch. Three standard models are available in 1/2-to-6-, 4-to-12- and 10-to-18-inch ranges. According to the manufacturer, they can be used with Number 1 AGD (American Gauge Design) standard dial indicators, or with any air-gauge instrument by means of an adapter block and a contact air cartridge. Each model includes a pair of carbide contact gauging fingers, two wrenches, an adapter block for O.D. checking and five sets of rest buttons to gauge at 1/32-, 3/32-, 5/32-, 7/32-, and 9/32-inch depths and is furnished complete in its own case.



Circle 19E on reply card

A self-contained, compact seal for use on rotating shafts in all types of jet water and oil pumps, reduction units or appliances such as washing machines, has been introduced by The Garlock Packing Company. Designated the BA12A-10, the unit has a face of fired carbon to prevent porosity. It is capable of withstanding high loading and heat. Roll-designed bellows have been incorporated to allow greater travel than was possible with former V-seal-type bellows. A brass metal shell of rigid 2-piece design imparts great stability and strength. A static O-ring held firmly in a groove within the seal shell permits sealing of higher pressure—gives a tighter fit. Units are available for 3/8- and 3/4-inch-diameter shafts with pressures to 100 psi, general operating limitations of 212°F, shaft speeds to 1000 feet per minute and liquids that will not attack the Buna-N flexible or brass metal parts. Variations in dimensions of the ring and/or the stationary seat, or materials specifications of seal components are also available.

Circle 20E on reply card

For high temperature applications in control systems on electroplating tanks, dyeing and bleaching machinery, chemical vats and process tanks, instantaneous water heaters, sewage disposal systems and similar situations that require rapid response and adjustable controls, Fulton Sylphon Division of Robertshaw-Fulton Controls Company has developed a pilot-type thermostatic controller that accurately regulates liquid or air temperature

when used in conjunction with valves, dampers or other controls. Designated as model 1100C,D, and called Fultrol, it is available in standard temperature ranges of 250 to 450°F and 350 to 550°F; however the company reports that it can be supplied in any 200° range from 50 to 600°F. The 3 13/16x19 3/4-inch unit consists of a stainless steel rod-and-tube



thermal element with straight-through action, a finned thermal isolator and a pilot valve. Its construction eliminates the need for critical, troublesome levers and pivots, thus making dismantling and reassembly in servicing and cleaning operations easy.

Circle 21E on reply card

King Engineering Corporation is producing a desiccant-type dehydrator for use in instrument lines. Known as the King Instrument Air Dryer, it is designed to remove water vapor from compressed gases serving liquid-level gauges, louver and damper operators, air valves



and other pneumatic equipment on dead-end or low-flow service in remote locations. According to the manufacturer, it provides a dew point of -60°F or lower, can be used at a gauge pressure of 100 psi and has a capacity of 60 surface cubic feet per hour at 70°F. The 19 1/2-inch unit consists of a brass and bronze

3-inch head and case and an inexpensive plastic-coated aluminum desiccant cartridge. The head is mounted "straight through" in the line and does not have to be removed for servicing. The case, containing the cartridge, screws onto the head, and has a drain cock in the bottom. Air enters from the right, flows down, around and up through the cartridge and through a saturation indicator that turns from blue to pink when the cartridge needs to be changed. The change is quickly made without tools and the saturated cartridge can be reactivated by heating it. Details and installation and operating instructions are given in 4-page Catalogue No. 3150.

Circle 22E on reply card

BRIEFS

Celanese Corporation of America is now producing Fortiflex, a plastic resin that reportedly possesses rigidity, heat resistance, toughness and chemical inertness. Sometimes described as "low-pressure polyethylene," its uses as wire insulation, film packaging material and automobile parts as well as for bottles, housewares and lightweight toys are foreseen. It is expected that 40 million pounds of the substance will be turned out at a new plant near Houston, Tex., every year.

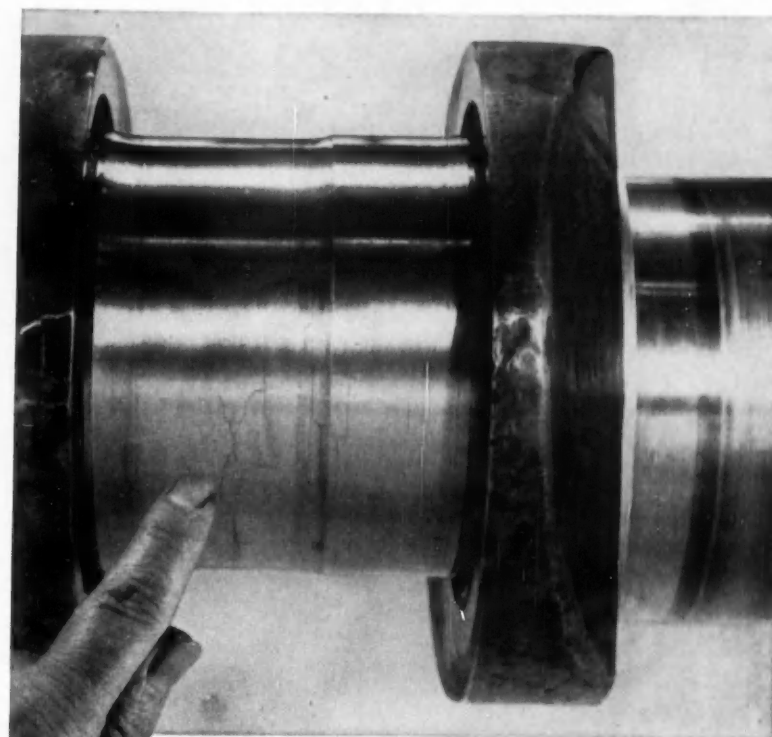
You can now have a building faced with ceramic bearing an almost pure gold finish. The Bettinger Corporation, of Waltham, Mass., makes it by applying a very thin layer of 22-carat-gold powder by a new fusing process. The method was worked out in cooperation with a manufacturer of gold powder and resulted from a request by a Boston company for a gold ceramic suitable for pumps dispensing a new golden-grade gasoline.

West Germany's steel industry is moving liquid raw metal on an 11-mile railroad from furnaces at Duisburg to Siemens-Martin-Werke in Mulheim. Each train car is equipped with a 60-ton-capacity tank, the contents of which is kept at 1400°C. Reportedly, moving steel in this form rather than in ingots, increases the railroad's handling capacity by 10 percent over the former method of chilling the metal and then reheating it upon its arrival at the destination.

A new type of portable power plant for oil-well drilling rigs is being tried out by Shell Oil Company in Colorado. It consists of four 200-hp diesel-engine-driven generators on a tractor trailer and can go into service immediately by running cables to a drilling rig. The time thus saved will, it is expected, increase actual drilling time of the average rig by the equivalent of several weeks a year.

Thanks to an inflatable rubber life raft, crewman from the wrecked vessel *Jane Jorgensen* spent 15 hours afloat last fall without appreciable discomfort. They slept normally, played cards and didn't even get their feet wet. Despite heavy seas and gale-force winds that would have made survival improbable in a small lifeboat, everybody was able to keep dry and warm.

The dawn of the Atomic Age has led Illinois Institute of Technology to schedule a course in the design of blast-resistant structures. It will be taught by Raymond W. Sauer who has been investigating nuclear explosion effects for the past 6 years.

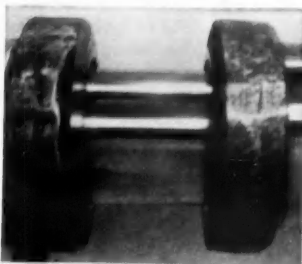


THIS CRANKSHAFT JOB NEEDS A SPECIALIST

This is specialized work, rebuilding crankshafts—intricate, exacting, and naturally expensive. It's the kind of work that demands a specialist . . . and we are just that!

We've specialized in rebuilding crankshafts, because since 1916 we've *made* crankshafts. And who knows better than a maker what are the "musts" of a sound, economical repair job. We'll take your worn crankshaft and rebuild it, if salvagable, through the carefully controlled steps of grit blasting, replating, regrinding and thorough inspection. And we'll deliver it back with a guarantee for 100% performance that only a manufacturer-specialist can provide. May we quote on your next job?

For more details on crankshaft repair write for Bulletin RC-4

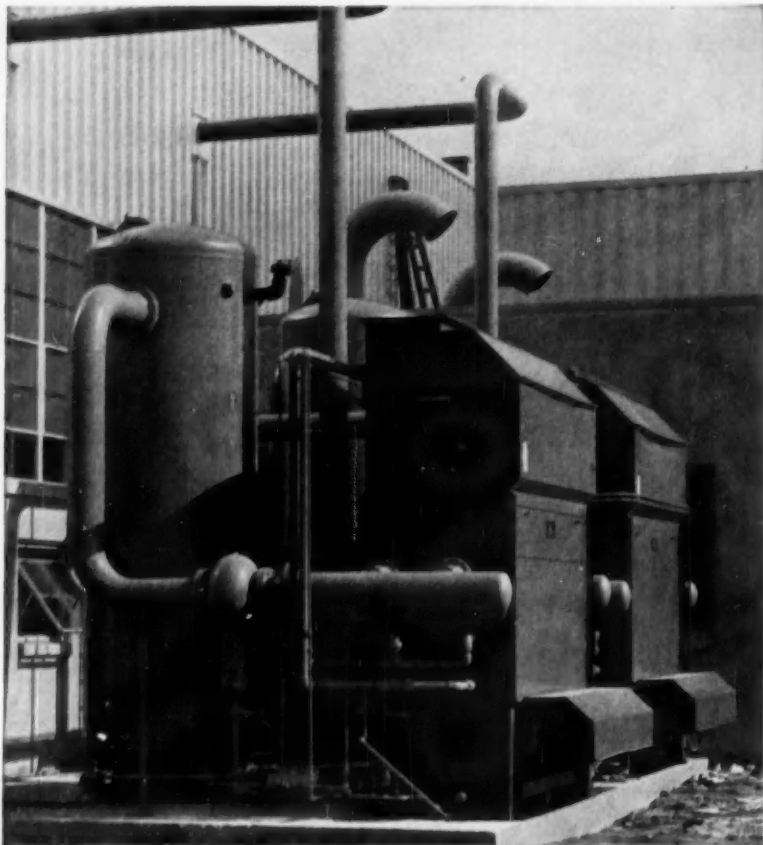


This is a finished, repaired crankshaft, after processing by National Forge.

NATIONAL FORGE
AND ORDNANCE COMPANY

Irvine (Warren County), Pa.

Circle 24A on reply card



This Niagara Aero After Cooler also cools compressor jacket and intercooler water.

COMPRESSED AIR... Lower in Cost Dependably Drier and Cooler Trustworthy for Instrument Use

THE NIAGARA AERO AFTER COOLER offers a completely self-contained method replacing both shell-and-tube cooler and cooling tower. It is independent of a large supply of cooling water and consistently reduces compressed air temperatures to below ambient. Its drier air gives you a better operation and lower costs in the use of all air-operated automatic instruments, tools and machines, paint spraying, sand blasting and moisture-free air cleaning.

Direct saving in the cost of cooling water saves the price of the Niagara Aero After Cooler in less than two years. Water saving also means less expense for piping, pumping, water treatment and water disposal, or you get the use of water elsewhere in your plant where it may be badly needed.

Niagara Aero After Cooler assures all these benefits because it cools compressed air or gas below the temperature of the surrounding atmosphere; there can be no further condensation in your air lines. It condenses the moisture by passing the air thru a coil on the surface of which water is evaporated, transferring the heat to the atmosphere. It is installed outdoors, protected from freezing in winter, proven in service on the largest plant utility air systems.

Write for complete information; ask for Bulletin No. 130

NIAGARA BLOWER COMPANY

Over 35 Years of Service in Industrial Air Engineering

Dept. CA-3, 405 Lexington Ave.

New York 17, N. Y.

District Engineers in Principal Cities

Circle 25A on reply card

Industrial Books, Films and Literature

Acoustical Materials Association has announced a comprehensive and concise story of architectural acoustics and materials. Originally prepared in slide and booklet form for colleges, the publication is now available to personnel engaged in, or allied with, the architectural and/or sound-conditioning fields. Sponsored by the Producers' Council and Association of Collegiate Schools of Architecture, the booklet combines information from many scattered sources and presents black and white reproductions of 58 color slides, each accompanied by one to six paragraphs of text. It covers the nature and causes of sound and noise, acoustical analysis, prepared remedies and information on acoustical materials, applications, methods of manufacture and installation. Stress is given to problems in auditoriums, offices and building corridors. Single copies of the picture story may be obtained free from Acoustical Materials Association, 57 East 55th Street, New York, N. Y., and complete sets of the color slides can be ordered from Audio-Visual Services, Syracuse University, Syracuse, N. Y.

Architects and engineers will be interested in Perlite Institute's 80-page design manual that is bound in loose-leaf form. It offers specifications, data and detailed drawings for complete roof and floor systems, curtain wall back-up and other building sections. When properly used, the publication will reportedly save many hours on every job requiring perlite insulating concrete and gypsum plaster. Cross references are minimized because each section, of which there are eighteen, is complete in itself and features architectural detail, perspective drawings, photographs, sources of supply for specially required materials and the like. Because duplicate units are obtainable, copies may be given to men at the construction site and to contractors preparing bids. Both long and short guides are included so that the writer need only fill in blanks to prescribe physical properties of all materials involved and to establish performance characteristics of the finished system.

Circle 23E on reply card

Highway Life Lines, a 16 mm, sound-color film, depicts methods for selection, evaluation and application of traffic paints and factors that influence their performance. Using Parlon-base varieties, the movie demonstrates that performance and cost on various types of surfaces, can be realistically predicted. Requests for prints of the film should be addressed to the Advertising Department, Hercules Powder Company, Wilmington 99, Delaware.

Latest advances and accessories available in the Pfaunder Company's line of glassed-steel polymerizers are outlined in Bulletin 932. Standard designs are rated for temperatures up to 350°F with internal pressures from full vacuum to about 175 psi, coincident with 80-psi jacket pressure, according to the report.

Circle 24E on reply card

For protection of commercial, laboratory and industrial equipment, Robertshaw-Fulton Controls Company offers Model H2 control thermostats. According to Bulletin RT-809, the unit, intended for use with electrical equipment only, is available for temperatures up to 800°F and will activate automatically when a preselected limit is exceeded.

Circle 25E on reply card

A 4-page folder illustrating and describing an electric-powered fork truck called Safe-Hite, has been published by Elwell-Parker Electric Company. Designated as Model F-48T2, the unit has front-wheel drive, hydraulic lift and tilt mechanisms and a 2000-pound capacity. Reduction in the height of the operator's seat makes it especially suitable for use where low headroom is a factor.

Circle 26E on reply card

Haynes Stellite Company, a division of Union Carbide & Carbon Corporation, has published a booklet on burnishing rollers, wear strips, valve-seat inserts, battery machine parts, half-bushings and half-sleeves, valve sections and knives made of cobalt, nickel- and iron-base alloys. Detailed procedures are given for heat-treating, machining, grinding and forming the parts.

Circle 27E on reply card

Halocarbon Division of Haveg Industries, Inc., has published Bulletin No. T-100, second in a series about Teflon and equipment made from it. The first treated the material in general and this brochure details its non-contaminate, non-adhesion and corrosion-resistant qualities that specially suit it for pipe linings in food processing, chemical, petroleum and pharmaceutical industries.

Circle 28E on reply card

Combustion Controls and Instruments, offered by General Controls Company, describes automatic draft-control instruments and actuators; solenoid, diaphragm- and motor-operated valves for oil, gas, steam and water; time switches; relays; and oil burner primary controls. Reportedly this is the first time a complete and standardized line has been catalogued under one cover.

Circle 29E on reply card

Gas-pressure manometers, oil-flow graduated, sling psychrometers, air-velocity meters, filter gauges, recording thermometers, carbon-monoxide detectors, kits for testing gas-heating equipment, carbon-dioxide indicators, smoke testers, draft gauges, flue-gas thermometers and pressure-point testers are described in Bulletin No. 138, published by General Scientific Equipment Company.

Circle 30E on reply card

Trends and Developments for Electrical Design Engineers includes information on permanent magnets, Thermistors and Thyrite varistors. Published by General Electric Company's Metallurgical Products Department, it is divided into four sections and discusses the subjects in relation to designers' problems.

Circle 31E on reply card

Lubricants for Stamping and Deep Drawing, a 4-page bulletin issued by Magnus Chemical Company, presents information for more precise selection of proper lubricants for given operating conditions. Detailed descriptions and applications for each product in the line are presented.

Circle 32E on reply card

For personnel in the water and sewage, power and processing industries, Simplex Valve & Meter Company has revised its 36-page general catalogue (No. 005). All major equipment manufactured by the company for the measurement and control of liquids and gases is listed.

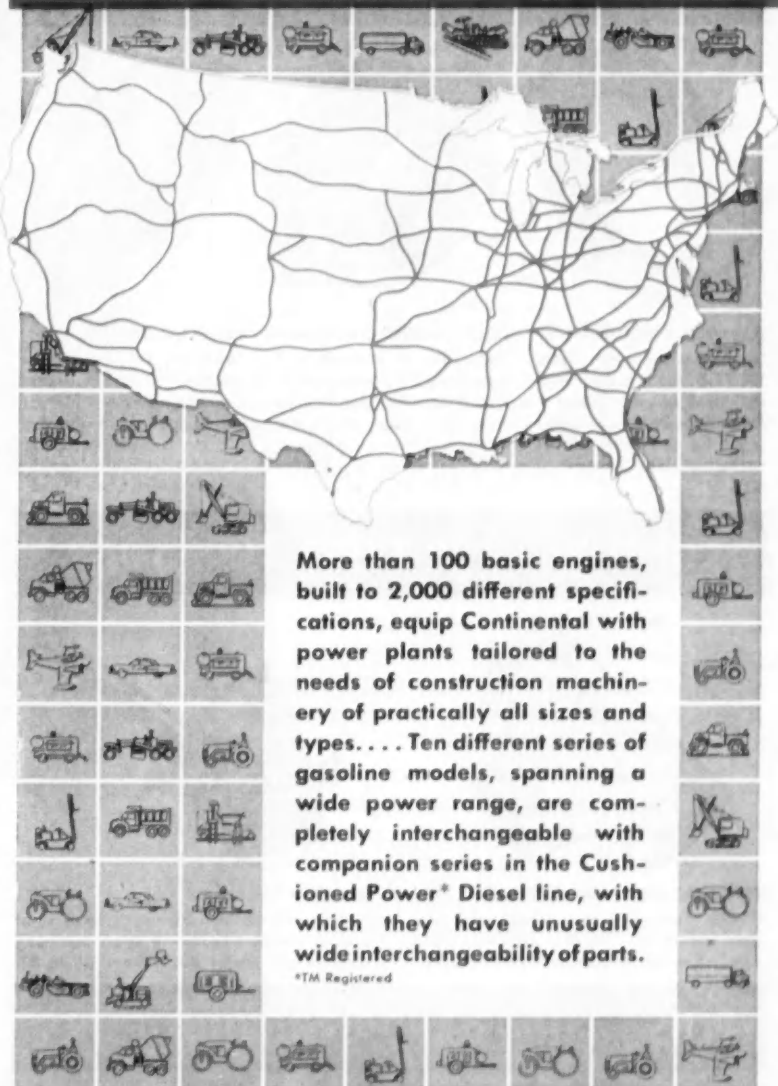
Circle 33E on reply card

A complete, packaged combustion assembly utilizing gas-, oil- or gas-and-oil firing for converting existing boiler equipment or for obtaining efficient operation from new equipment is described in *Fuel Burning Systems* (Bulletin No. 1231-A), published

MORE Power... BETTER Power...



for Every Phase of the BIG ROAD PROGRAM!



More than 100 basic engines, built to 2,000 different specifications, equip Continental with power plants tailored to the needs of construction machinery of practically all sizes and types. . . . Ten different series of gasoline models, spanning a wide power range, are completely interchangeable with companion series in the Cushioned Power* Diesel line, with which they have unusually wide interchangeability of parts.

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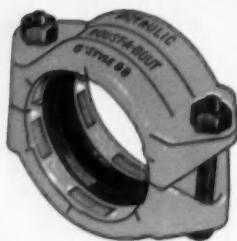
METHOD OF PIPING

VICTAULIC HAS EVERYTHING...



VICTAULIC COUPLINGS

Simple, fast, reliable. Styles 77, 77-D, for standard uses with steel or spiral pipe, — Style 75 for light duty. Other styles for cast iron, plastic and other pipes. Sizes $\frac{3}{4}$ " to 60".



ROUST-A-BOUT COUPLINGS

For plain or beveled end pipe Style 99. Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 8".



VICTAULIC SNAP-JOINTS

The new, bottless, speed coupling, Style 78. Hinged into one assembly for fast piping hook-up or disassembly. Hand locks for savings in time and money. Ideal for portable lines. Sizes 1" to 8".

COUPLINGS FOR EVERY PIPING JOB



VICTAULIC FULL-FLOW FITTINGS

Elbows, Tees, Reducers, Laterals, a complete line—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes $\frac{3}{4}$ " to 12".



VIC-GROOVER TOOLS

Time saving, on-the-job grooving tools. Light weight, easy to handle — operate manually or from any power drive. Sizes $\frac{3}{4}$ " to 8".

PLUS FITTINGS AND GROOVING TOOLS

"EASIEST WAY TO MAKE ENDS MEET"

Promptly available from distributor stocks coast to coast.
Write for NEW Victaulic Catalog-Manual No. 55-B-3

VICTAULIC COMPANY OF AMERICA
P. O. BOX 509 • Elizabeth, N. J.

Circle 27A on reply card

by Orr & Sembower, Inc. Complete flexibility of the unit permits its use on furnaces, ovens, vats, kilns, dryers, boilers and many other types of diversified heat-exchange equipment. Three installations are described in detail.

Circle 34E on reply card

In a pamphlet on threads, Standard Pressed Steel Company warns against the danger of accepting over- and undersize screw threads and describes how it can be avoided. The publication points out that two intrinsically different types of thread gauges—a functional one for verifying high-limit tolerance and a pure-pitch-diameter variety for low-limit-tolerance checks—must be used to provide a true indication of fit. Although the discussion is of Class 3A threads, the closest interchangeable screw-thread fit, it applies equally, in principle, to the gauging of other classes.

Circle 35E on reply card

Specifications, dimensions, ratings and applications for series DSC, SA silent and DRC roller chain couplings, as well as tabulated information on stamped steel, plastic and split aluminum covers are contained in a 16-page catalogue issued by Morse Chain Company. Circle 36E on reply card

Lunkheimer Company has revised Circular No. 555, a reference guide for selecting valves, boiler mountings and lubricating devices. Sections covering recent design developments in valves have been added to the 24 pages of tables and technical data. Circle 37E on reply card

Air release valves of cast iron in $\frac{1}{2}$ - to 1 $\frac{1}{2}$ -inch body sizes for pressures up to 250 psi and of cast steel in $\frac{1}{2}$ to $\frac{3}{4}$ -inch sizes for pressures up to 500 psi are published in Bulletin No. 856, released by V. D. Anderson Company.

Circle 38E on reply card

An index (Bulletin G-2) listing catalogues, bulletins, specification and data sheets, illustrated lectures and articles from *Instrumentation Magazine* may be obtained by writing to Minneapolis-Honeywell Regulator Company, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Selenium-rectifier and DC-motor-generator arc welders for industrial applications, AC- and DC-engine-driven types for construction and maintenance work and AC-transformer varieties for plant, garage and shop use are illustrated and described in Catalogue No. 1340, published by Air Reduction Sales Company. Specifications for each are included.

Circle 39E on reply card

Bulletin No. 750, by Simplex Valve & Meter Company, describes a pneumatic transmission, called Laminair, that provides sensitive and accurate instrumentation. The mechanism produces an air pressure output that varies directly with flow through a venturi tube, flow nozzle or orifice plate.

Circle 40E on reply card

Advantages of iron-powder electrodes, performance factors and AWS (American Welding Society) specifications are covered in a folder (Form No. 106) issued by Hoeganaes Sponge Iron Corporation. Technical data about iron powder, Ancor W-428, as rod-coating are also given.

Circle 41E on reply card

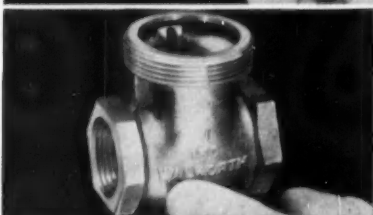
Design, installation and application details of high-capacity, fast-acting, spray-type steam desuperheaters are described in Bailey Meter Company's Specification No. M55-1.

Circle 42E on reply card

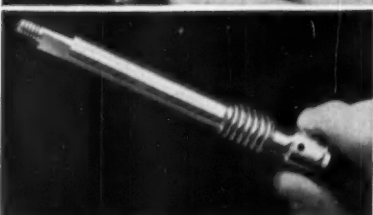
Here's what makes Walworth Bronze Valves *the* real bargain!



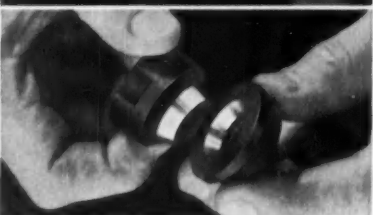
TYPICAL OF WALWORTH QUALITY is the union body-to-bonnet connection which stiffens the body against internal pressure; makes taking the valve apart a simple operation and reduces the chances of distortion or leakage even though the valve is repeatedly taken apart and reassembled. With this type of construction there is no possibility of the bonnet coming off the valve while the handwheel is being turned.



HEAVY BODY CONSTRUCTION is typical of all Walworth Bronze Valves. Extra-thick walls and rugged wrench hexes constitute a high safety factor and prevent distortion while the valve is being installed in the pipeline. Extra-deep pipe threads are accurately machined to eliminate leakage. Walworth Bronze Valves are also available with flanged, silver-brazed or soldered ends in certain sizes and types.



EXTRA-LARGE STEMS with extra-long, extra-deep threads prolong valve life, protect against wear and distortion and provide tight positive shutoff. The surface of the stem is machined to a glass-like finish for minimum handwheel effort and to preserve the packing which results in fewer inspections and less maintenance. The top of the stem is tapered and squared to hold the handwheel securely.



TO REDUCE WIRE DRAWING to a minimum, certain types of bronze globe valves have stainless-steel plug-type seats and discs heat-treated to a nominal hardness of 500 Brinell, adding years to valve life even in severe services. These valves can be tightly closed on sand, grit or pipe scale without damage. Seats and discs are machined simultaneously, assuring perfect mating.

There is a Walworth Bronze Gate, Globe, Angle or Check Valve for every service. Walworth is continually developing new valve types and materials, including plastics, to keep pace with the growing variety and severity of services in modern industry. For full information, see your Walworth Distributor or write: Walworth, 60 East 42nd Street, New York 17, N. Y.

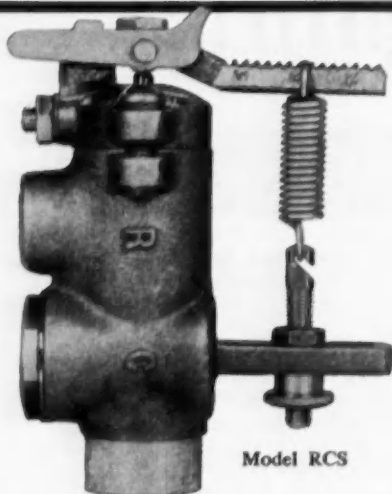


WALWORTH

Bronze Valves and Fittings

CONRADER UNLOADER VALVES

**Positive . . . Accurate . . . Dependable
Time-tested the World Over**



Model RCS

New Designs—Smaller—More Compact

Positive operation in any position.

Adjustable differentials.

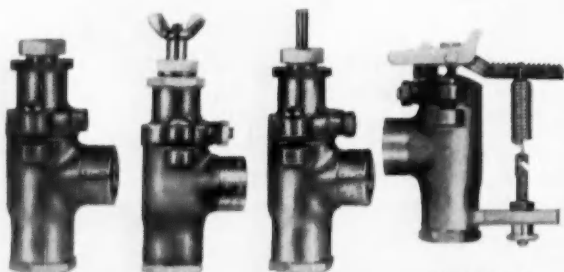
Operating pressures from 4 p.s.i. to 600 p.s.i.

Standard on leading compressors.

Conrader's exchange service trades you a completely rebuilt valve for an old one with new valve guarantee.

One day service on repairs.

Conrader is equipped to custom design special valves in pressures to 1000 p.s.i.



Model RCW

Model RCM-A
with hand unloader

Model RCM-A

Model RCF
(Available with
drain cock)

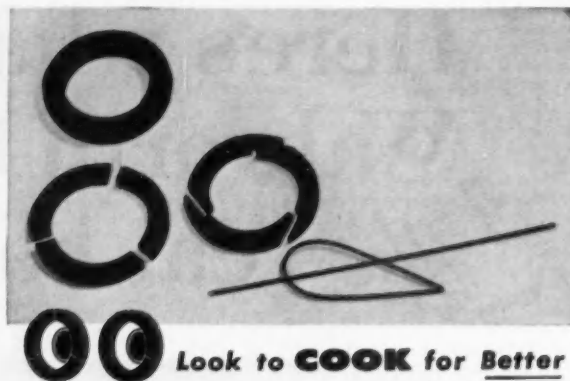
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Circle 29A on reply card

Adv. 30



PACKING RINGS!

Whatever your packing-ring requirements, you can depend on Cook for a ring design and ring material that will deliver maximum efficiency at minimum cost.

One source, one high standard of quality—that's what you get when you specify Cook—packing-ring pioneers since 1888. Write direct for complete technical data. C. Lee Cook Company, 930 So. 8th St., Louisville 8, Ky.

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MATERIALS

GRAPHITIC IRON

(Exclusive with Cook)

COOKMET

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(Laminated Bakelite; Standard, Hi-Temp and Graphitized)

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(For Non-Lubricated Service)

**C. LEE
COOK
COMPANY**

Sealing Pressures Since 1888

Circle 30A on reply card

**NO MOISTURE
OR DIRT
GETS BY HERE**

Johnson Self-Draining Compressed Air Separator

Like all Johnson Separators the new Type "SA" Self-Draining Separator combines the two most effective principles of removing moisture and dirt from compressed air:

1. Controlled expansion of air in separator precipitates most of the moisture.
2. A "thousand baffles" of coarse mesh repeatedly changes flow of direction to capture remaining foreign matter.

Self-Draining—a simple but complete trap mechanism built right in, automatically drains separator whenever necessary.

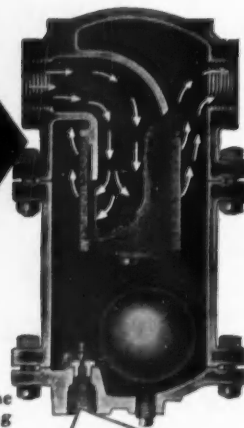
WRITE FOR CATALOG

The Johnson Corporation

830 WOOD STREET



THREE RIVERS, MICH.



Circle 31A on reply card

COMPRESSED AIR MAGAZINE



BLAST!

BIG ones like this

or small ones, too!

. **More Economically with
Norbide® Pressure
Blast Nozzles**

THERE'S a NORBIDE Nozzle available to give you exactly the type of cleaning stream you need — from a broad stream for large areas to a pencil-thin stream for cleaning small openings. And NORBIDE Nozzles — lined with the hardest manufactured material commercially available — maintain stream contour, last longer than any other nozzle made and deliver maximum blasting efficiency at minimum cost per hour.

For full details on cost-cutting NORBIDE Nozzles, write for your free copy of Form 543.

NORTON COMPANY
41 New Bond St., Worcester 6, Mass.



NORTON®
BORON CARBIDE

NORTON PRODUCTS: Abrasives • Grinding Wheels
Grinding Machines • Refractories
BEHR-MANNING PRODUCTS: Coated Abrasives
Sharpening Stones • Behr-cal Tapes

NORBIDE® . . . The Longest Nozzle Life You Can Buy

how to get the most out of HOLLOW DRILL RODS

Detachable carbide insert bits are a cost-cutting tool for the hard rock driller. But their use presents problems to the blacksmith. One problem is the premature failure of the attachment on the drill rod. When that happens, time is wasted in trying to recover the bit and, often, valuable bits are lost.

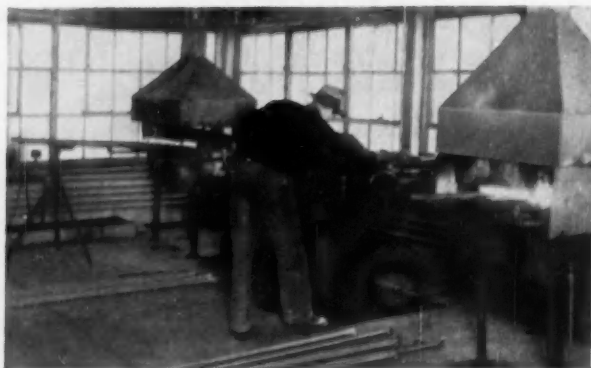
But, with new alloy steels such as Crucible CA DOUBLE DIAMOND or 4E, plus careful control of operations in the forge shop, you can keep failures to a practical minimum.

For example, prevent **SCALING OF THREADED SECTION**



Excess scaling may produce undersize threads, loose fitting bits and ultimate mechanical failure of the drill rod due to poor stress distribution. Here are a few precautions to take to prevent excess scaling:

TIME AND TEMPERATURE—



Of primary importance are the time and temperature which the heat-treater selects for the job. Although they will vary somewhat with the composition of the steel and the size of the rod, time and temperatures should be selected which are the minimum at which the desired result can be obtained. Excess furnace time or temperature will result in excessive scale formation.

FURNACE ATMOSPHERE — Avoid a highly oxidizing flame. The higher the excess oxygen content, the greater the tendency for scale and decarburization to form. And a reducing flame leads to carburizing brittle threads. The furnace best operates with a "soft" smoky flame or under near neutral conditions.

SCALE REMOVAL—



Scale is abrasive, and unless what scale does occur is removed, thread wear results. Wire brushing is a fast, convenient and safe method for removing scale.

Crucible hollow drill rods are tough, strong—made to tool steel standards. Their *extra* quality means less rod breakage—fewer valuable bits lost. So specify Crucible hollow drill rods for your next job. They're quickly available in the sizes, types and grades you need. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE

first name in special purpose steels

Crucible Steel Company of America



Near Candlestick Point, outside of San Francisco, a 6-yd. 150-B loads borrow to help build a new freeway.

in California... and the World Over

Match big construction jobs with big-production equipment — Bucyrus-Erie Electric Shovels

When construction jobs call for big yardage in extra tough digging, the advantages of a Bucyrus-Erie electric shovel are more valuable than ever. Because these heavy-duty excavators are built to handle even the most demanding jobs, they can be expected to keep dirt-moving costs down in any work.

Modern front-end design reduces power-wasting dead-weight, yet provides plenty of strength. Heavy-duty construction throughout holds down upkeep, lets you get maximum working time out of every shift. Ward Leonard variable-voltage control provides high speed acceleration and deceleration, assures maximum torque and power when it's needed most.

On future jobs, figure the savings you can expect from Bucyrus-Erie Ward Leonard electric shovels. They are helping make a profit for more and more contractors.

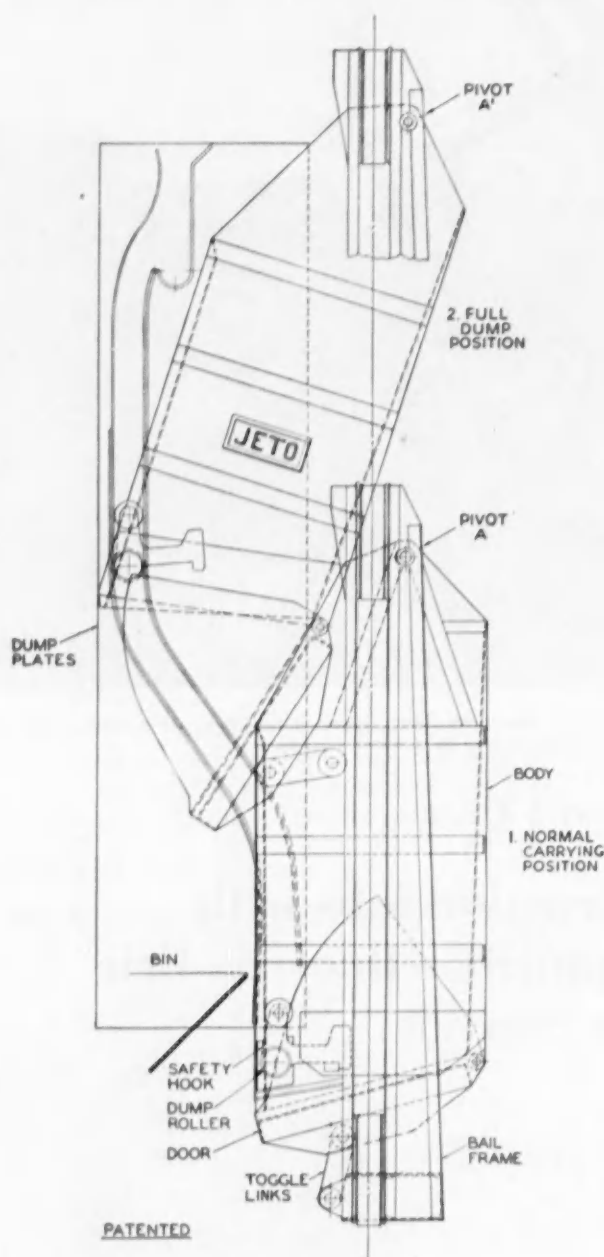
112L56C



BUCYRUS-ERIE COMPANY

South Milwaukee, Wisconsin

Lake Shore's "JETO" bottom dump skip dumps 20% faster — HERE'S HOW IT WORKS



This engineer's drawing shows Lake Shore's "Jeto" bottom dump skip; 1, in normal carrying position, 2, in full dump position. The skip body swings outward from the bail frame on pivot point "A" while toggle links open the bottom door.

How the "Jeto" skip is made

The two principal parts of Lake Shore's "Jeto" bottom dump skip are the bail frame and the body of the skip. They move vertically in the shaft guides. When the dump position is reached, the body swings out and the ore is jetisoned. The dumping mechanism consists of a pair of dump plates (or scrolls) mounted at the dumping station, and dumping rollers, safety hook rollers, toggle door release links, all mounted on the skip.

How it works

As the loaded skip moves into the scrolls, the safety hooks unlock the body from the bail frame, the dump rollers swing the body outward. With the outward movement of the body, toggle links attached to the skip door and the bail frame open the skip door and the ore is dumped. In full dump position, the door is in line with the back of the skip body, and the ore flows unrestricted from the skip. When the skip moves down, the same mechanism closes the door and swings the skip body back into the bail frame.

Why the "Jeto" reduces ore handling costs

"Jeto's" bottom dump is 20% faster than a Kimberly, means more skip loads per day.

Sticky ore dumps clean every time.

Full weight of skip is on the rope at all times — improves hoisting balance.

Positive door action prevents accidental dumping—safety hooks keep body locked in bail frame until dumping station is reached.

When planning to replace a skip or to sink a new shaft, talk to the people at Lake Shore: Find out how the "Jeto" can reduce ore handling costs in your operation.

LAKE SHORE, Inc.

Lake Shore Engineering Division
IRON MOUNTAIN 5, MICHIGAN

How to step up compressor performance

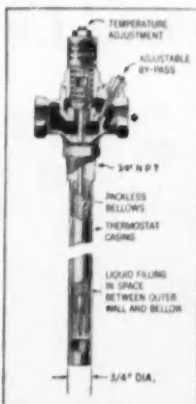
You know how *over-cooling* (1) causes condensation in cylinders which destroys lubricant, increases wear; (2) wastes water.

Under-cooling reduces compressor capacity—often damages cylinders, pistons, valves, seats.

You can easily avoid these costly troubles by equipping your compressors with simple, inexpensive Sarco self-powered cooling controls. They insure optimum cooling effect with minimum water consumption...regardless of variations in load, pressure, and supply water temperature.

Write for Handbook 520-A "Is Your Air Compressor Capacity Effective?"

SARCO COMPANY, INC.
EMPIRE STATE BUILDING, N. Y. 1, N. Y.



SARCO T-44 COOLING CONTROL

Self-powered—requires no electrical or compressed air hook-up. Adjustable temperature ranges.

Inexpensive; less than \$40

Complete Sarco line includes Cooling Controls with remote bulbs.

2128-P

Circle 36A on reply card



**BUY
BOTH
BOOKS
FOR
\$5.00**

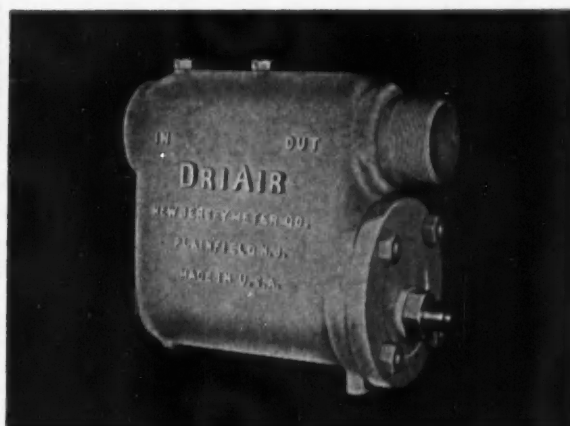
Price Individual Books	Per Copy
Compressed Air Data (Fifth Edition)	\$3.00
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COMPRESSED AIR MAGAZINE, 942 Morris Street, Phillipsburg, New Jersey.
Please send me:

- ☐ Compressed Air Data and Cameron Hydraulic Data. Both books for \$5.00.
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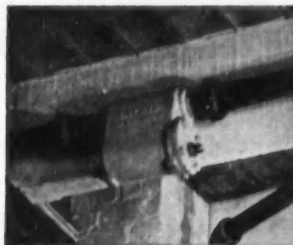
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DriAir

A COMPLETE SELF-CONTAINED UNIT



DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and

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Whatever your job, you can count on dependable performance from Naylor pipe in its full range of diameters from 4 to 30 inches.

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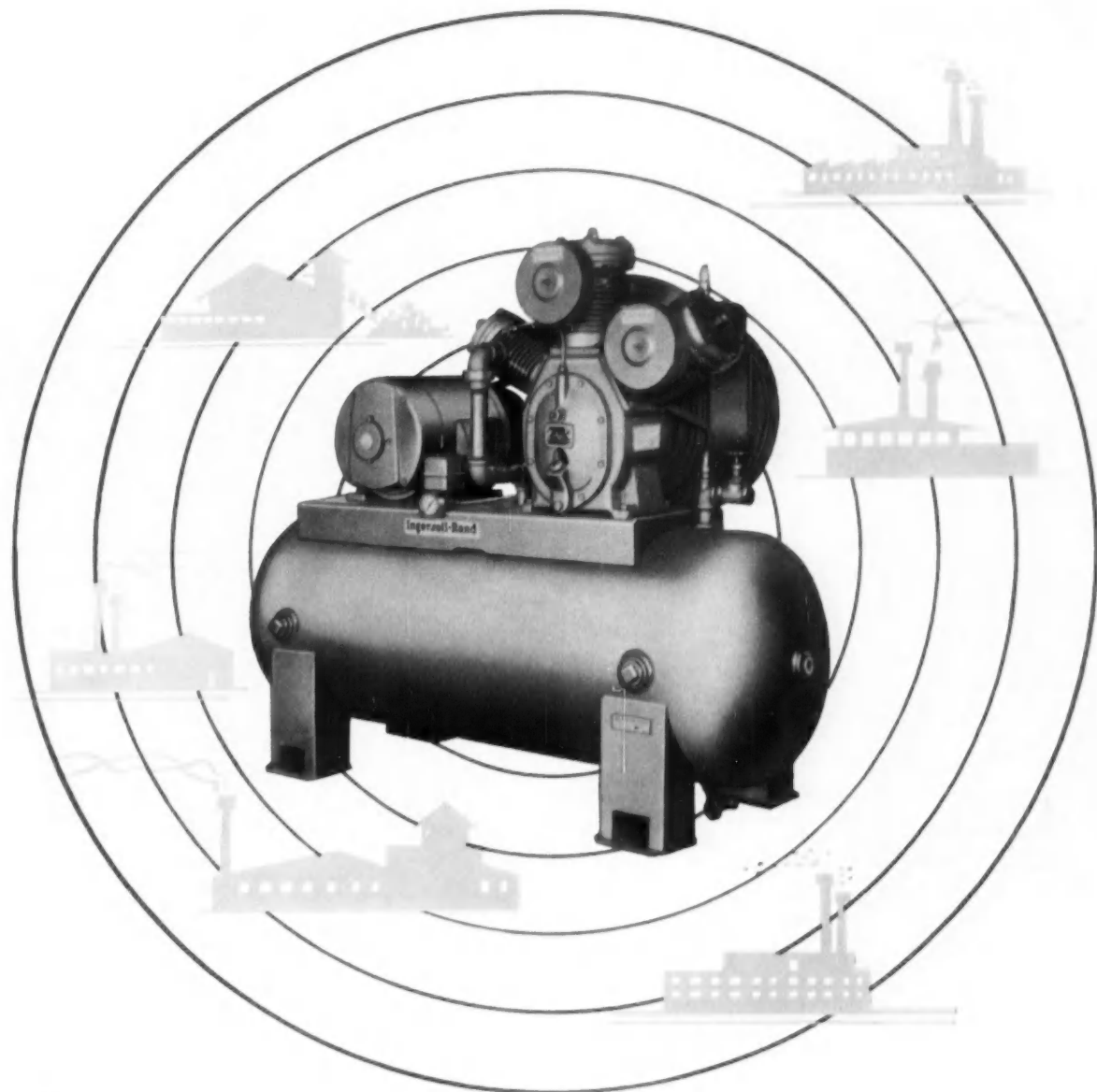
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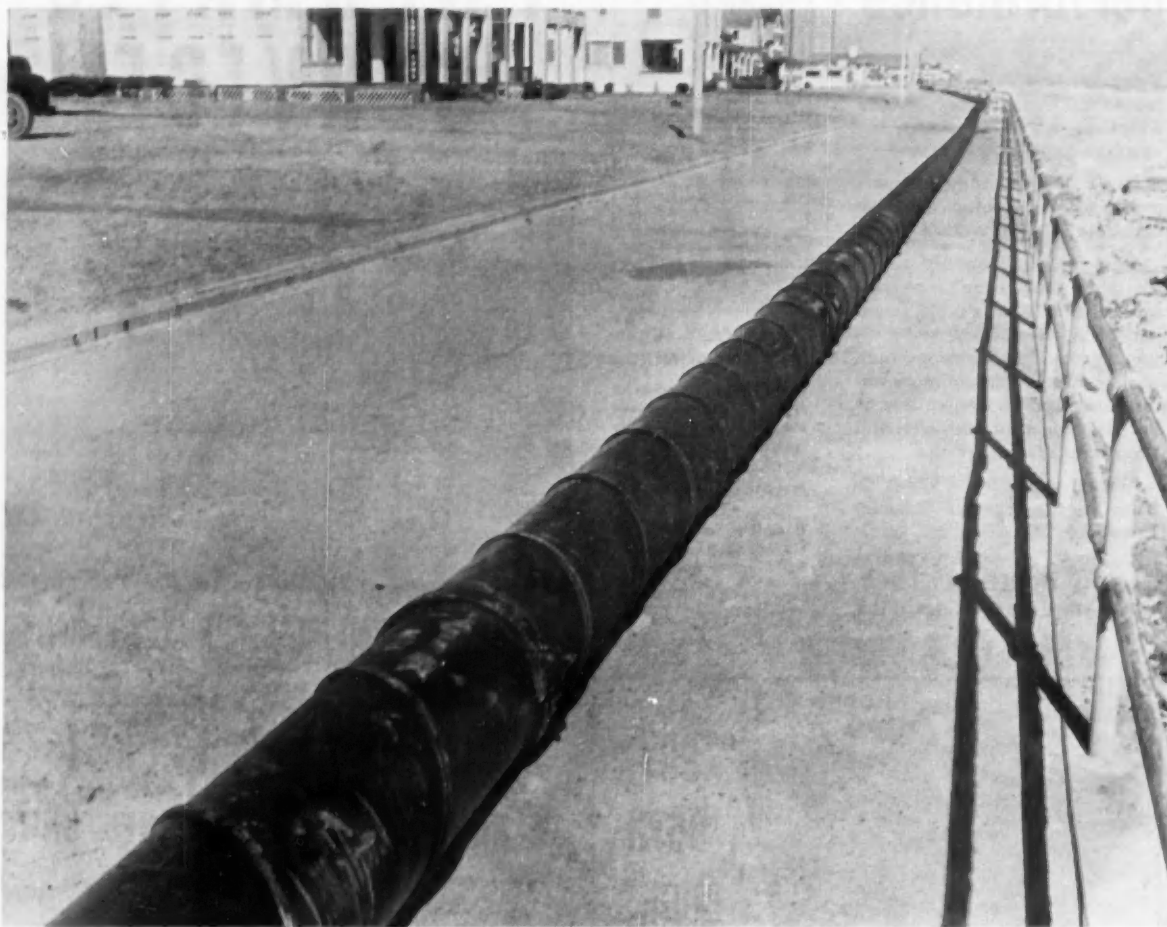
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